THE COMPLETE PHOTOGRAPHER

THE JESTER

BY FRANK H. READ

REPRODUCED FROM THE ORIGINAL OIL-PRINT IN COLOURS

THE COMPLETE PHOTOGRAPHER

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R. CHILD BAYLEY

EDITOR OF "THE AMATEUR PHOTOGRAPHER AND PHOTOGRAPHY"
AUTHOR OF "PHOTOGRAPHY IN COLOURS," ETC.

WITH SIXTY-FIVE FULL-PAGE PLATES
AND MANY TEXT ILLUSTRATIONS

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PREFACE

NOBODY who has once come under the spell of the camera, and has so far penetrated into the mysteries of photography as to be able to expose with a reasonably quiet mind as to the ultimate nature of his negatives, can ever thereafter free himself completely from its fascination. I have been under the spell for over thirty years, but my camera is as good a companion as ever, and photography is as entertaining in 1920 as in 1885. And incalculably easier also.

The great reduction in its difficulties and complications has made the camera vastly more popular; but at the same time it has had the curious and unforeseen result that, comparatively speaking, there are fewer amateurs to whom its use is their chief hobby. Formerly success was only to be attained by concentrating one's whole attention on the processes employed, and photography was the pursuit of a few enthusiasts. To-day, while almost every one photographs, there has not been so vast an increase in the number of enthusiasts, although the increase has been a large one. Many have been led by its facility to take it up casually, and have found that even in that way it will furnish a great deal of pleasure and of attractive and useful occupation. Some of these are led further and further in its pursuit. They find that in spite of hand-cameras, mechanical development, and gaslight papers, there is still plenty of scope for the exercise of personal skill; there are plenty of difficulties to confront and triumphs to achieve, and that as a pastime an inexhaustible field opens out before them as they proceed. To such a field the later chapters of this book may serve as an introduction.

It was pointed out in the preface to the first edition that

"The Complete Photographer" made no attempt to be either a scientific treatise on underlying principles, nor a reference or "how-to-do" book of the kind with which the field is already amply provided. Formulæ have been omitted as far as possible, partly because every packet of plates or papers includes them, still more to counteract the tendency to regard them as forming the key to success. Too many have stuck hopelessly amongst prescriptions, going from one to the other in the hope of finding some magic fluid that shall dissolve all the obstacles in their path, not realizing that it is not the formula but its use that is at fault. I have striven to show that successful photography is neither a matter of formulæ nor of costly and elaborate apparatus, but of careful work, attention to minutiæ, especially of cleanliness and neatness and practice.

Since the first edition was published in 1906, there has been a gradual but a great change in photographic practice, and whole chapters have required rewriting. This was particularly the case with the sections on the "Hand-camera" and on "Colour Photography." Screen-plate work, ozobrome, and bromoil, have all been introduced in the interval, while the reflex camera, orthochromatic work, and gaslight printing have undergone great developments.

Acknowledgments are due to Sir William Abney and General Waterhouse for help on the subjects of colour photography and the evolution of photography respectively, to Mr. Mummery upon gum-bichromate, to Mr. Stieglitz on pictorial work, and to the many able photographers, some personal friends and others only known to me by name, who have enabled me to illustrate the book with so choice a collection of photographic pictures.

R. C. B.

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THE telegraph, the steam-engine, the dynamo, the motor car, most notable applications of the great forces of nature to the service of man, are the product, not of the single inspiration of brilliant genius, but of toiling and plodding on the part of many often obscure and unrecognized inventors. The photograph, as we have it to-day, is no exception. It is the final outcome of two distinct chains of invention, each with its beginning hidden in the mist of antiquity. The forging of their links has been the work of many hands, and the credit of the production of either, much less of the result of their union, the photograph, must be shared by a score or more at the very fewest. But just as in the case of the telegraph, where the work of Wheatstone and Cooke suddenly crystallized into practical form the results of a long series of discoveries, of Porta and Galvani and Volta, of Oersted and Weber and Faraday, so the processes of Daguerre and Talbot, based on the work of Schulze, Scheele, and Wedgwood in one line, and of Aristotle, Euclid, Alhazen, Bacon, Barbaro, Porta, Kepler,

as well as less-known physicists, in the other, enable us to fix the "discovery of photography," in the popular sense, as taking place some time between 1834 and 1837. The reservation "in the popular sense" is necessary, as, in the strict etymological sense, "photographs"—that is, "light-drawings"—were made in 1727 or earlier; but a photograph in common parlance means a picture produced by the camera, and those of Schultz were made by contact, while some of Niépce's bitumen plates bore negative images obtained in the camera it is true, but scarcely pictures. Great as was the step made by Daguerre, its importance was hardly recognized at the time, if we are to judge from the fact that the French Government awarded an annual pension of £240 to him, and of £160 to his partner Niépce, in return for which princely remuneration, the discovery was to be thrown open to the world. To form a correct notion of his work, and that of his contemporaries, notably Talbot and Herschel, we must turn to the earlier pages of the record.

I

The operations which constitute photography are twofold—first, the formation of a light-image by the lens and camera; and, second, the fixing or recording of that image by chemical means. The discovery that images could be seen of necessity preceded the search for a chemical method of recording them, and, as a matter of fact, we find that the camera obscura was familiar for centuries before there is any evidence of an attempt to fix its pictures.

In Eastern lands, where science had its earliest votaries, houses are dark within while the scene without is bright. How early in point of time it was noticed that when one small hole in a darkened room allowed the light to enter, a picture of what was going on outside was visible on the opposite wall, it is impossible to say. But where the conditions were so favourable it must have attracted the attention of such close observers of nature as the Chaldean and Egyptian sages. Aristotle notes that when the sun shines through a square hole upon some surface at a distance from it, the spot of light is not the shape of the hole, but is circular, and that during an eclipse the spot takes the shape of the sun for the time being.

Euclid also combined instruction with amusement when demonstrating to his pupils the rectilinear passage of light, by the projection of images of outside objects in a darkened room, through an aperture in the window shutter. These cases are parallel to that of a camera with a pinhole instead of a lens, still sometimes used by photographers. From the room with its accidental chink and whitened wall, to a structure made for the express purpose of showing such images, cannot have been a great step; but no trace remains of the man who made the first intentional stride towards photography. Firm ground is only reached when we get to Roger Bacon's "Perspectiva," written about 1267, wherein he describes, not very clearly it is true, an apparatus with a speculum, by which it is possible to see images of what is going on in the street, so that "those looking will run to the image and think the things are there when there is nothing but merely an apparition." Bacon speaks of a "speculum," or mirror, and one of the earliest forms of camera used in photography actually had a mirror instead of a lens, although for practical purposes, except in celestial photography, the mirror was soon abandoned for the lens. The first record of a box for viewing or projecting pictures is of one constructed in 1437 by L. B. Alberti, which was probably a rough form of camera obscura or magic lantern. Leonardo da Vinci, who was well versed in optics and in the theory of vision, has left unpublished manuscripts, now in the Bibliothèque Nationale at Paris, which contain a very distinct account of a pinhole camera, with a diagram; but he does not claim it as his invention, nor even as a novelty. As Leonardo da Vinci died in 1519, it is clear that at whatever period of his life this was written, it must have been long before the time of Giovanni Battista della Porta. Porta is, however, generally quoted as the inventor of the camera obscura, which he describes in his "Magica Naturalis" published in Naples in 1558. In this book the camera is provided with a "speculum"—*i.e.* a mirror—and it was left for Daniello Barbaro to give the first account of a camera with a lens, which he did in a work on perspective, published at Venice in 1568. Barbaro not only describes a camera and lens, but actually alludes to the use of a stop in sharpening up the picture. The passage is remarkable enough to quote in full.

"Having made a hole in the window of the room from which you wish to observe, as large as a spectacle-glass, then take an old man's glass convex on both sides, not concave, like the glasses of youths with short sight, and when it is fixed in the hole, shut all the doors and windows of the room so that no light may enter except by the lens. Now take a sheet of paper and place it in front of the glass, so that you see clearly all that is outside the house. This takes place most distinctly at a determinate distance, found by bringing the paper nearer to or farther from the glass till you have found the proper position. Here you will see the images on the paper as they are, and the gradations, colours, shadows, movements, clouds, the rippling of water, birds flying, and everything that can be seen. For this experiment the sun must be clear and bright, because the sunlight has greater power in bringing out the visible images. When it pleases you to make the experiment, you should choose the glasses which do best, and should cover the glass so much that you leave a little of the circumference in the middle which should be clear and open, and you will see a still brighter effect. (This seems to be the first mention of the use of a diaphragm in sharpening the image.) Seeing, therefore, on the paper the outline of things, you can draw with a pencil all the perspective, and the shading and colouring, according to nature, holding the paper tightly till you have finished the drawing." *

Not Barbaro only, but another Venetian, Benedetti, refers to the use of a camera and lens some years before it was published by Porta in the second edition of the work to which reference has already been made. The early history of the camera has been the subject of a long and painstaking investigation by Major-General Waterhouse, and it is curious to notice that he was led to anticipate that the invention might very likely be found to proceed from Venice, from the fact that the seat of glass manufacture in those times was there. He seems to have left no room for doubt that Porta not only was anticipated by Bacon, Da Vinci, and others in

* "La Pratica, della Perspettiva," by Monsignor Daniel Barbaro, eletto Patriarcha d'Aquileia, Venice, 1568. Translation in "Notes on the Early History of the Camera Obscura," by Major-General Waterhouse. The *Photographic Journal*, N.S., xxv. pp. 270 *et seq.*, from which much in this chapter has been taken.

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the description of a darkened room and pinhole, which had been utilized by Maurolycus, Reinhold, and others for observing eclipses from 1520 onwards, but also by Barbaro and Benedetti with the camera and lens. Another link with Venice is found in the biography of the Venetian painter Canaletto, who seems to have been the first artist to make use of the camera in obtaining the outlines of his subjects. The man who really turned the camera obscura to practical use as a sketching instrument, and laid down the optical principles on which the projection of images by single lenses or combinations of them depended, was the great astronomer, Johann Kepler, in his optical treatise "Dioptrice" (1611). When Sir W. Wotton visited Kepler in 1620, he saw a landscape drawing executed by the aid of a portable camera, and wrote a quaint description of it to Lord Bacon, from which an extract was published in a book called "Graphice; or, The Most Excellent Art of Painting," printed for R. Crofts in 1658.

"The draught of a landskip mathematicall; they that have leasure, and desire thereto, may make experiment. A Landskip. Set up a little black tent in a field, made easie, portable and convertible, as a windmill, to all quarters at pleasure; capable of no more than one man with little ease; exactly close and dark, save at one hole, an inch and a half diameter, to which apply a long prospective trunck, with a convex glasse; fitted to the said hole, and the concave taken out at the other end, which extendeth into (about) the middle of this erected tent, through which the visible radiations of all the objects without, are intermitted, falling upon a paper which is accommodated to receive them, and so trace them with pen in their naturall appearance, turning this your little tent round by degrees, till you have designed the whole aspect of the place. There is good use hereof in chorography; but *to make landskips hereby were too illiberall.* Surely no painter could exceed the precisenesse of these."

The "Scioptrick ball" was a wooden globe pierced and fitted at one end of the opening with a lens. The ball was so held that it could be turned about, and a camera fitted with it was sold in 1704 by Mr. Marshall at "the Archimedes" on Ludgate Hill. Such cameras were called "Scioptricks." In the latter half of the eighteenth century the camera seems to

have become quite common, both as a show and for sketching purposes. There were many besides Canaletto who did not hold with Crofts that its use "were too illiberall." Some were made with mirrors to get over the difficulty of the picture

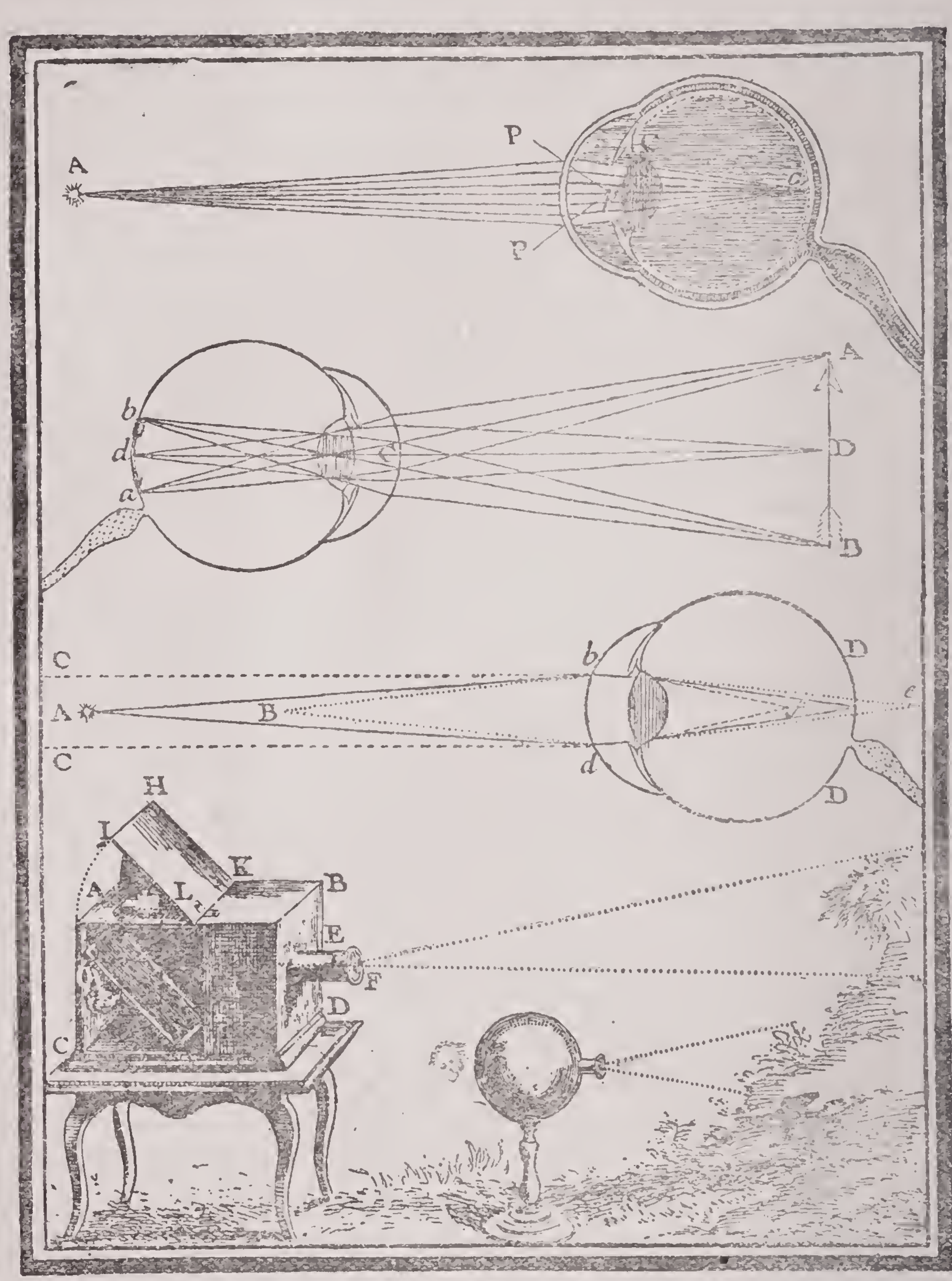

FIG. 1.—AN EARLY CAMERA, AND DIAGRAMS SHOWING THE ANALOGY BETWEEN IT AND THE EYE ("Leçons de Physique." Nolet. Paris: 1755.)

being reversed or wrong way about, some were large and the observers got inside, others small and portable and fitted with a mirror within, which reflected the image on to a horizontal screen on the top of the box. Such an instrument is figured in "Leçons de Physique," by the Abbe Nollet, published in Paris

in 1755, and the plate, which we reproduce, is of interest, as demonstrating the analogy between the camera and the eye, and the fact that the nearer the object is brought to the lens, the further away on the other side of the lens is the sharp image.

A discovery which ultimately had a very important bearing on photography had in the mean time been made by an Essex gentleman, an astronomer, Mr. Chester More Hall. He, like all other users of lenses, had been inconvenienced by their want of what is now spoken of as "achromatism." Any lens made of a single piece of glass not only refracts or bends aside the light which passes through it, but bends each colour to a different extent. The result is that images with such lenses appear to have coloured edges or fringes surrounding them, especially when the lenses are used as they are in telescopes. It was generally supposed, on no less an authority than that of Sir Isaac Newton, that this defect was insurmountable. In his "Optics" Newton stated that "refraction could not be produced without colour," for which reason "no improvement could be expected in the refracting telescope." Hall, however, found that, contrary to Newton's supposition, all glass, while bending or refracting the light, did not separate the colours to the same extent, and that it was possible by combining lenses of two different kinds of glass (crown and flint) to make a compound or "achromatic" lens, which should form an image without separating the different colours at all, or at least perceptibly. He took no pains to make his invention public, however, and the discovery of the achromatic lens is, therefore, often attributed to John Dollond, an optician, who described to the Royal Society in 1758 how it was possible to remedy both "chromatic aberration" and "spherical aberration", by making lenses of more kinds of glass than one. This was the foundation stone on which all modern lenses for the microscope and telescope as well as for the camera, with their exquisite perfection of design, construction, and performance, have been made. Lenses made on this principle to give the best results to the eye, as in the telescope, are not the best suited to photographic uses; and the construction of a properly corrected photographic lens was not put in hand until the demands of photography called it forth; but the principle of Hall's

discovery was none the less important, and when lenses for photography were wanted, it was only necessary to modify the glasses and their curvatures to accommodate the lens to the new requirements.

This has brought us down to the latter part of the eighteenth century, when the first recorded attempt was made to fix the images obtained in the camera, by applying the existing knowledge of the chemical action of light. But before we can understand the nature of this attempt, we must retrace our steps, and see what the chemists had done while the physicists were evolving the camera.

II

It must have been noticed at a very early date indeed that light affected certain bodies in an unmistakable manner. Probably the first of its effects to attract observation was the fading of dyed fabrics. The famous Tyrian purple we now know to have been anything but a permanent colour, and some of the cheaper and commoner dye-stuffs of the ancients were similarly fleeting. The greatest of all the manifestations of light-action, the conversion of carbonic acid and moisture in the air into vegetable matter by means of the chlorophyll in the leaves of plants, escaped observation until comparatively recent years, but very primitive gardeners must have noticed that by heaping earth round the stems of plants, the parts so protected remained colourless or nearly so, whence the deduction that in some way the colour is due to light is simple and direct. Changes in the colours of fruit and flowers by solarization are noticed by Aristotle.

The beginnings of photographic chemistry are generally attributed to the alchemists. These early metallurgists, giving much of their time to the investigation of the precious metals, undoubtedly succeeded in making silver nitrate and possibly silver chloride; but if they noticed that fabrics treated with either substances turned dark when exposed to light, they have not recorded the fact.

The first accounts of silver ores and native silver chloride, or "horn silver," which were sometimes observed to change

colour after being extracted from the mines, are found in the metallurgical writings of Agricola, Fabricius, Kentmann, and others living in the Saxon mining districts round Meissen, and familiar with the minerals found there. Fabricius, a Saxon scholar and poet of the sixteenth century, who wrote a short supplement to Agricola's great work on metals and mining, has generally, but quite erroneously, been looked upon as an alchemist, and has been the subject of a curious legend, started apparently by a French historian of photography. Fabricius, so it is said, not only prepared silver chloride, but found that "it became suddenly black as soon as a ray of sunlight fell on its surface"—which it certainly does not—and acting on the hint this phenomenon afforded, he projected upon the surface of silver chloride the image formed by a glass lens, which imprinted itself thereupon, and so made the first photograph. Unfortunately, an examination of the works of Fabricius reveals no account of any experiment so remarkable; he refers to a semi-transparent, horn-coloured ore of silver, or to the form of silver chloride known as "horn silver," but apparently he was not aware of its most remarkable characteristic of changing colour in light. The writings of the alchemists have many references to silver nitrate, and Porta, who did not invent the camera, was certainly familiar with this salt, though he did not know that it was sensitive to light. He observes that it is possible to disguise one's self by applying a solution of silver nitrate all over the body—a most effective method, no doubt.

The actual discovery that light was the active agent in causing this darkening of silver nitrate was made by Johann Heinrich Schulze, and, like many another, was purely accidental. He tells us that, wishing to treat some chalk with nitric acid, he happened to use acid he had at hand in which a little silver had been dissolved. Mixing this with the chalk, and working near a window, he was surprised to find that the mixture in the dish turned dark where the direct rays of the sun fell upon it, but was unaltered in the parts not reached by the sunlight. The fact that struck him most was that the result of the action of light should be darkness. We have to view the experiment through the theories of a couple of centuries ago, to realize how strange this must have seemed to Schulze. It attracted

his attention so strongly that he laid aside the work on which he was engaged, to follow up the clue thus accidentally acquired. Friends suggested that the change was due to heat and not to light, but this he disproved by showing that it was possible to make a bottle of the mixture so hot in front of a fire that the hand could not bear it, and yet not get the darkening that sunlight soon brought about. He thought at first that his sensitive material was made by the mixture of chalk and aqua fortis, but failed to get any darkening when these substances were used. It was only after many experiments that he recollected that there was silver in the acid he had first used, and then by saturating acid with silver he got more marked results than at first. He cut out letters and figures from sheets of opaque paper, and putting these round bottles of the mixture and exposing them to light, he obtained true photographic impressions, but written, if not in sand, in still less stable material. For we must not forget that Schulze's bottles contained nothing but a kind of chalky sludge, and it needed but a swirl to mix up the contents and the images disappeared in a moment. None the less, for the first time he had produced images by means of light, and intentionally; and that first step, if not taking him far on the road towards photography as we know it, was at least the first step, and a notable one. He published an account of his experiments in the *Acta* of the Cæsarean Academy for 1727; and there seems every reason to believe that it was from an account of Schulze's experiments that Wedgwood got the suggestion for his own.

The sensitive material in Schulze's experiments was silver nitrate, and it is possible that the effect of light upon it was noticed before his time; for he himself remarks, in the paper in which he published an account of them, that he had "often found a solution of silver made with aqua fortis does not get dark in a quite dark place, while when exposed to the sun a dark red colour is induced, verging afterwards towards blue." The chalk was only a vehicle, and he found that magnesia, "ceruss of lead," and other substances could be employed in a similar manner. Silver chloride, or luna cornea, it was long known, gradually darkened in colour when exposed; but it was assumed, as by Robert Boyle, that the darkening was due

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to the air. Thirty years after Schulze, Beccari of Bologna suspected that this change was due to light. He enclosed some of the luna cornea in a glass vessel and placed it in front of a window, but some distance within the room. He soon found that the side turned towards the window had changed to violet, while the back remained white. On the vessel, over parts of the unaltered chloride, he stuck black paper, and exposed it to light until the following day, when he found that the substance had turned violet everywhere except where the paper had protected it.

Schulze's experiments were repeated by Dr. William Lewis of Kingston-on-Thames, who carried his investigations into the action of light much further. He found that ivory, bone, wood, and stone, treated with nitrate darkened in sunshine, and observed that compounds of bismuth, of gold, and of mercury were light-sensitive. At the death of Dr. Lewis in 1781 his manuscript note-books were purchased by Josiah Wedgwood, the potter, who also took his assistant, Mr. Chicholm, Chisholm, or Chisolm into his service, as secretary and chemical assistant; but in this we are anticipating.

The next stage was an important one, and was made at the other end of Europe. Carl Wilhelm Scheele, of Stralsund, knowing doubtless of the discovery of Schulze, and that silver chloride as well as silver nitrate was affected by light, set himself to find out the nature of the change, and to ascertain whether all kinds of light affected the silver salt equally. By a series of experiments he convinced himself that silver chloride in sunshine was converted into metallic silver, which was the dark-coloured product, and that if it were exposed under water, the water subsequently contained muriatic acid. Liquor ammonia, the alchemists knew, was a solvent of silver chloride. Scheele found that it did not dissolve the darkened product obtained by exposing silver chloride to light. It does not appear that he realized from this that it might possibly act as what we now describe as a "fixing" agent; and in the subsequent experiments of Wedgwood there is no mention of ammonia being tried for this purpose, though he found he was quite unable to fix his pictures. Throwing upon a surface sensitized with silver chloride the band of coloured light from a prism, Scheele found that the darkening action took place

more quickly in the violet than in the other colours. He must have performed this experiment in a very casual manner, as he failed to notice that quite half of his visible band of colours, the green probably and the yellow and red certainly, had no effect on the chloride at all. Scheele published an account of his work in 1777. In 1801, Ritter, repeating these experiments more carefully, found that not only was the sensitive substance unaffected by red, yellow, and green light, but that there existed invisible radiations—now known as the ultra-violet—which changed it even more powerfully and quickly than violet light itself.

Prof. Jacques Alexandre Cesar Charles, a public lecturer on physics in Paris, is said by Frenchmen (on extremely doubtful grounds) to have made silhouettes by casting the shadow of a person's profile on paper made sensitive with a salt of silver. Charles was a notable man in his time. He was the first to ascend in a free balloon; and he fought and wounded Marat, with whom he had some difference on a scientific subject. No record whatever of his alleged experiments seems to exist, and the basis for the claim is an assertion made in 1839 by Arago. He dated the experiments as being made in "the first years of the nineteenth century."

This sketch has now brought us down to the end of the eighteenth century. By that time scientific men at least were familiar with the fact that some mineral compounds were sensitive to light, and that minute holes, mirrors, and lenses were each capable of forming an image of external objects on a suitably placed surface. It remained to apply the one process to the other to produce a camera picture, and the attempts, unsuccessful and successful, to do this form the third stage in photographic history.

III

Pre-photographic legends of pictures made by natural or by magical means are in existence, the Chinese, of course, having a tradition of this kind; but the most explicit accounts are to be found in the two French works "Un Voyage Supposé," by Fenelon, published in 1690, and "Giphantie," by Tiphaigne de

la Roche, published in 1760. These are curious anticipations of photographic processes, but are not sufficiently definite even to suggest the problem to an experimenter, and it is not at all likely that either was known to those who subsequently took up the task of making photography possible.

In the latter part of the eighteenth century a remarkable group of men were living in the Midlands, scattered about, it is true, but meeting from time to time, frequently corresponding, and constantly in sympathy, if not always in agreement. The best known of the group are Dr. Priestley, Josiah Wedgwood, James Watt and Matthew Boulton his partner, and Dr. Erasmus Darwin, a naturalist himself, and grandfather of a still more famous one. In 1771 was born to Josiah and Sarah Wedgwood a fourth son and fifth child, Thomas. Dr. Priestley, in 1772, published his "History of Discoveries relating to Light Vision and Colour," in which are described the experiments of Schulze and of Beccari already referred to. In 1782, we have seen that Chisolm, who had been Dr. Lewis's assistant, came to Josiah Wedgwood at Etruria, and amongst his other duties, he seems to have had much to do with the education of "Tom" Wedgwood. It is not surprising that a lad reared under these conditions, if of scientific taste at all—and Tom Wedgwood's tastes were markedly scientific—should have his attention drawn very strongly to these experiments with salts of silver. Wedgwood's scientific experimenting began before he was of age, and there is some reason for supposing that the work described to the Royal Institution in 1802 was performed in or about 1790–1792.

The great merit of Wedgwood as a photographic pioneer lay in the fact that he was the first to realize that it might be possible to use the light-sensitive properties of substances to make permanent the images given by the camera obscura. He was a confirmed invalid, dying at the age of thirty-four, and the latter years of his life were almost entirely spent in travel in search of health. Hence the extremely casual and unsatisfactory way in which the report of his photographic work has come down to us. It is contained in the first and only volume of the "Journals of the Royal Institution," and is entitled "An account of a method of copying paintings upon glass, and of making Profiles, by the agency of Light upon Nitrate of

silver. Invented by T. Wedgwood, Esq. With observations by H. Davy." In this account, which seems to have been written by Davy, we are told that white paper or white leather moistened with solution of silver nitrate speedily changes colour on being exposed to light. Red rays have very little effect on it, yellow and green are more efficacious, but blue and violet light produce the most decided and powerful effects. The leather he found more readily acted upon than the paper, an observation in which lay the germ of "development." The phrase "paintings on glass" in the title refers to originals so prepared, from which copies could be printed on the sensitive paper or leather, in the method now so well known. Wedgwood failed in his attempts to fix these prints. Repeated washings would not remove the unaltered silver compounds sufficiently to prevent the white parts darkening when exposed to daylight afterwards. Varnish was tried without avail, and these copies therefore had to be kept in the dark, and examined only by the light of candles or lamps. The following extract describes the first recorded attempt to obtain camera pictures :—

"The images formed by means of a camera obscura have been found too faint to produce, in any moderate time, an effect upon the nitrate of silver. To copy these images was the first object of Mr. Wedgwood in his researches on the subject, and for this purpose he first used the nitrate of silver, which was mentioned to him by a friend as a substance very sensible to the influence of light; but all his numerous experiments as to their primary end proved unsuccessful. In following these processes, I (Davy) have found that the images of small objects, produced by means of the solar microscope, may be copied without difficulty on prepared paper. However, it is necessary that the paper be placed at but a small distance from the lens."

Here ended Wedgwood's invention: the fixing difficulty seemed to be insurmountable. Yet several substances were available had he known, and the universally used fixing agent "hypo" had been discovered by Chaussier in 1799. This difficulty discouraged others from working at the process, and Talbot himself, nearly fifty years afterwards, said that he learnt of the property of hypo before he read of Wedgwood's work, or he too might have been discouraged. The light-sensitiveness

of silver compounds was neglected from the date of the publication of Wedgwood and Davy's account for more than a quarter of a century. Wedgwood himself died July 10, 1805.

The next stage is curious, because it ignored almost all that had gone before, and started on a completely fresh line. Joseph Nicéphore Niépce, a middle-aged country gentleman living at Gras, near Chalon-sur-Saone, in South-Eastern France, was interested in the then novel process of lithography. His lithographic experiments commenced in 1813, and led him from the use of stones to that of metal plates, which he coated with various "varnishes." From this stage he was tempted to try to transfer to the plates, by the action of light, the line pictures which formed his originals. By 1816 he had succeeded in doing so, although in all probability, when so transferred, he could not copy them by "lithography" or any of its modifications. Two years later, as shown by his published correspondence, he was trying to get camera pictures by his method. He succeeded, although the exact date when he did so is uncertain. His great originality lay in the abandonment of silver salts as sensitisers, and in the use of resinous substances instead. Of these he found, in 1826, that "bitumen of Judea" was the most satisfactory. This mineral pitch or asphaltum he discovered to be soluble in oil of lavender except where light had acted on it. By giving a thin coating of the bitumen to a metal plate, exposing this to light under an engraving or design, and then washing the surface of the plate with certain essential oils—oil of lavender being the best for the purpose—the bitumen where the light had not acted washed away, where it had acted it remained. The result was a copy of the engraving, the lines being represented by bare metal, the clear spaces by bitumen.

The designs Niépce obtained in this way he called "heliographs," and many efforts were made by him both to make them more easily visible and to find some means of printing from these metal plates. The most promising methods were by acting upon the bare metal in those parts whence the bitumen had been washed away; this he did with various acids, and with iodine (which had been discovered in 1812 by Curtois). In the Châlon museum is an old print, oiled to make it translucent, and a number of proofs from it, which are said to have been printed from an engraved plate made in this

manner in 1826. This process of Niépce is remarkable, in that it was in extensive use until quite recently, some of the modern half-tone and line work having been printed on copper or zinc by a process to all intents and purposes that worked out at Chalon eighty years ago. The bitumen process, like some of the simpler organisms in nature, outlasted many of the more complex and elaborate methods of later date. It has now given way almost entirely to methods in which the action of light on a bichromated colloid is employed.

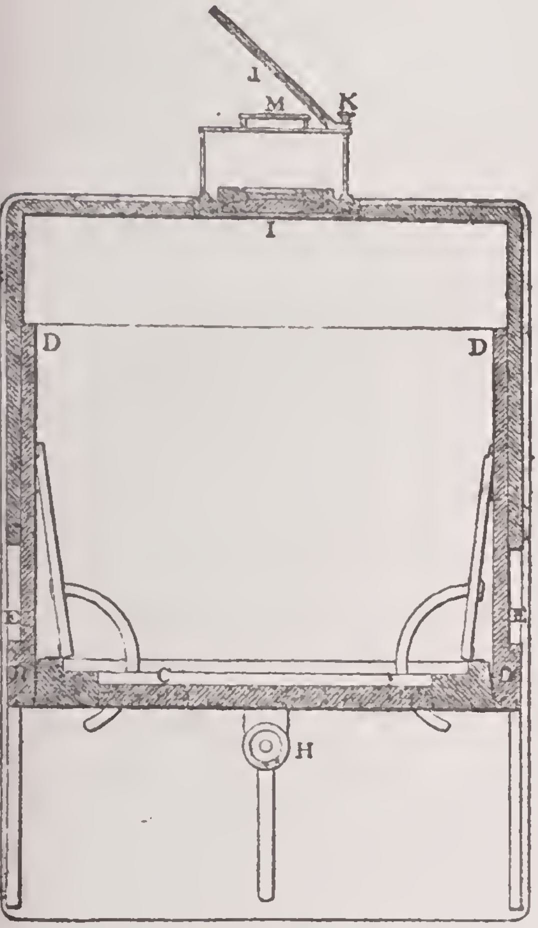
In the mean time a reputation had been made which extended far beyond its centre, Paris, by a very clever stage artist—he was much more than a scene-painter—named Louis Jacques Mandé Daguerre. He showed himself remarkably skilful in scenic effects, which reached their highest point in the Diorama, an entertainment he devised which was popular for many years. Daguerre had few of the characteristics of the conventional inventor; he was a gay man-about-town, and his career, to put it very mildly, would hardly commend itself to the worthy Dr. Smiles. He must have had much originality, however, and undoubted patience. Somewhere about 1824 he first entertained the idea of fixing the images of the camera obscura, an instrument he used in his scene paintings. He heard of the work of Niépce in 1826, wrote him, and the two inventors met in 1827. Two years later they entered into an agreement for ten years to work at the subject for their joint advantage, each communicating his results to the other. Until the death of Niépce in 1833, Daguerre seems to have worked on the lines of the bitumen process, in the details of which he effected some improvements. After that date, however, acting very possibly on a hint given to him by attempts to etch silver plates with iodine, he took up a distinctly novel line, which gave promising results in 1835, and in 1837 was sufficiently perfected to be the subject of a fresh agreement with the son of the first Niépce. The process, after an unsuccessful attempt to form a company, was given to the world in return for a pension from the French Government.

Daguerre's process was an immense advance in sensitiveness on everything which had gone before it; when details had been modified a little, it was even capable of being used for portraiture from life. It was, moreover, a positive process, not

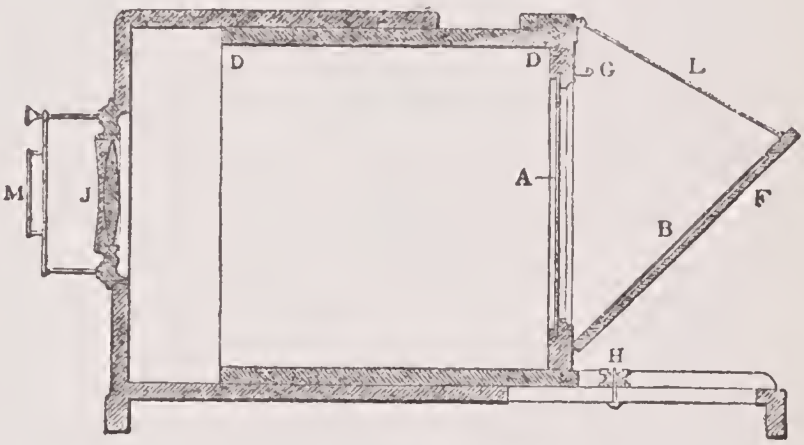
THE THAMES AT HAMPTON

BY J. CRAIG ANNAN

a negative one, and was more strikingly original than any other method, introduced before or since. A highly polished silver plate was submitted to the fumes of iodine until it was coated with a fine layer of silver iodide, and was then exposed in the camera. The plate was next transferred to a box in which it was held over a metal dish of mercury, heated from beneath by a spirit lamp. The vapour of mercury ascended, and the metal adhered to those parts which had been exposed to light, in proportion to the strength of the light. The



Horizontal section.



Vertical section.

FIG. 2.—THE CAMERA USED BY DAGUERRE.

"A is a ground glass by which the focus is adjusted; it is then removed and the photographic plate substituted, as in C. B is a mirror for observing the effects of objects, and selecting the best points of view. It is inclined at an angle of 45° by means of the support L. To adjust the focus, the mirror is lowered, and the piece of ground glass A used. The focus is easily adjusted by sliding the box D out or in, as represented in the plate. When the focus is adjusted, it is retained in its place by means of the screw H. The object glass J is achromatic and periscopic; its diameter is about one inch, and its focal distance rather more than 14 inches. M is a stop a short distance from the lens, the object of which is to cut off all those rays of light which do not come directly from the object to which the camera is directed. This instrument reverses the objects; this can be remedied by using a mirror outside, as at KJ. ("Photography." By Robert Hunt. 1853.)

unaltered iodide was dissolved away by means of a solution of salt—hypo was subsequently used for the same purpose—and the final result was a brilliant, well-defined picture, reversed as regards right and left, but with its lights the light-coloured mercury compound, and its shadows the polished silver surface, which, if held so as to reflect only dark objects, appeared dark, and so made the result a "positive," and not a "negative;"

though these terms were not introduced until the following year, when Herschel employed them "to avoid circumlocution." The process was termed Daguerreotype, and except for the application of bromine to the silver plate along with the iodine, made by Goddard in 1840, by which its sensitiveness was much increased, and a method of depositing gold on the image, introduced by Fizeau, which gave it more vigour and greater permanence, it was not modified or improved. It had a great vogue for portraiture from 1840 to 1851, when the wet collodion plate speedily made daguerreotype obsolete. Its exceptional character is shown by the fact that no other process originated in it, or borrowed anything from it. Daguerreotype, like its brilliant discoverer, stands alone and independent. Daguerre launched upon an astonished world a complete and practical photographic process — the first. It existed unmodified until made obsolete by a totally dissimilar method, when it died almost as suddenly as it appeared.

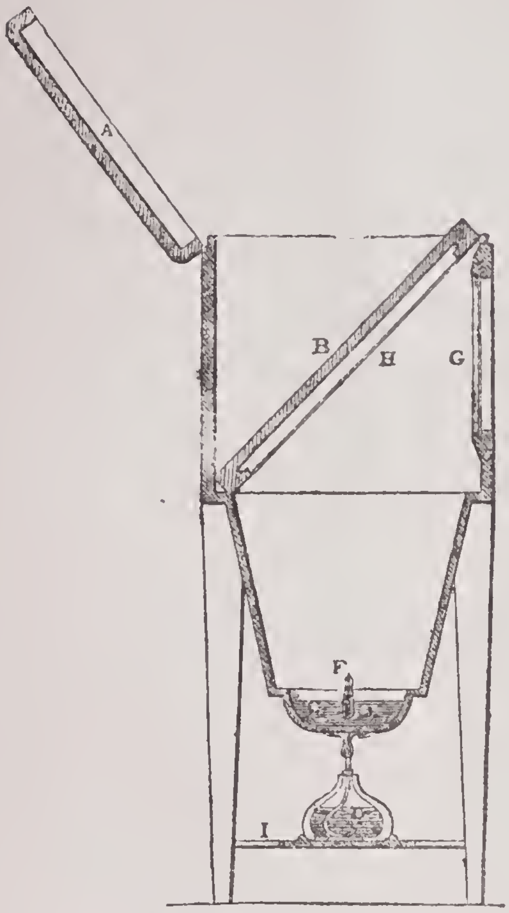


FIG. 3.—APPARATUS FOR DEVELOPING A DAGUERREOTYPE PLATE.

The plate H in a wooden holder, B, was introduced by means of the lid A. Mercury, C, was then volatilized by means of the lamp D, the support for which, I, was adjustable. A thermometer partly shown at FJ enabled the heat to be regulated, while the progress of development was watched by means of a candle or other feeble light through the window G. ("Photography." By Robert Hunt.)

It is time we got back to Wedgwood, and took up the silver nitrate and chloride thread again, which we dropped at his death. Nothing of note can be recorded until 1819, when Sir John Herschel (Herschel II.) published in the *Edinburgh Philosophical Journal* an account of his investigation into "hyposulphurous acid and its compounds." One of these is the now universally used "hypo" (hyposulphite of soda, or more correctly sodium thiosulphate), whose solvent properties on silver chloride were then not only pointed out, but thoroughly examined and described. It was in that paper that Herschel drew attention to a fact that many photographers even now

ignore—that to ensure the complete solution of the silver salt there must be a large excess of hypo present.

We now come to the work of William Henry Fox Talbot, an English gentleman of ancient lineage and scientific tastes, who is known not only for his photographic discoveries, but as one of the first decipherers of the cuneiform inscriptions and as a pioneer in modern illustrative methods: the photogravure process of to-day also is essentially his invention. He tells us in the "Pencil of Nature" that the idea of fixing the camera images occurred to him in 1833, and that he began experimenting in 1834. Daguerre's process was made public in the first fortnight in 1839; on January 25 of the same year Faraday exhibited prints by Talbot, and on January 31 Talbot read an account of his process to the Royal Society. We can accordingly settle on January, 1839, as the period when photography, as we understand it, though still imperfect, first became known to be practical. Talbot followed the lines of Wedgwood and Davy, but obtained greater sensitiveness by forming his silver chloride in the paper in such a way that there was left with it an excess of silver nitrate. It was by the presence of this silver nitrate that the speed of the paper was increased to such an extent that camera pictures became possible. During the brilliant summer of 1835, he tells us in the work already quoted, he had succeeded in getting camera pictures of his own house, Lacock Abbey, on paper sensitized by alternate washes of solutions of salt and of silver nitrate. The publication early in 1839 of Daguerre's method frustrated his hope of being the first to announce a practical photographic process, but there is no doubt that for some years both he and Daguerre, on different lines, had been making pictures in the camera — Daguerre by an original, and it is said accidental, discovery, Talbot by a method a direct outcome of that of Wedgwood and Davy. Talbot's first camera pictures, however, were not developments of a latent image; but the photograph—a negative one, of course—was printed right out in the camera. The discovery that a comparatively short exposure to light would give an image, but an invisible one, in a fraction of the time taken to print it out visibly, was made by Daguerre; although his development by mercury vapour bears no known relation to any other development

process, and was quite inapplicable to the paper process of Talbot.

IV

From the time of Talbot and Daguerre the stream of invention swept on in an ever-widening flood. The same year that marked the publication of their processes saw the discovery by Mungo Ponton,* that paper soaked in potassium bichromate was sensitive to light, that it underwent a change of colour on exposure, and that the image so obtained could not be washed out of the paper, although the bichromate could. This observation, to all appearances a curiosity and little more, laid the foundation of the carbon process, of gum bichromate, of ozotype, of collotype, of photogravure, of Woodburytype, and of some of the half-tone block processes, and, in the variety of the methods which sprang from it, has been absolutely unrivalled in photographic research. This was in 1839. The next year Sir John Herschel made photographs on glass plates by depositing silver chloride on them, but as there was nothing to hold the chloride to the glass and to act as a "sensitizer," the results were interesting, but no more.

The calotype process of Talbot must not be confused with his first method, in which there was no such thing as development. Calotype was patented in 1841, and, Daguerre's being first, was the second in which development played any part. The development of a calotype is the direct ancestor of the development of to-day. Wedgwood had noticed that white leather treated with silver nitrate was more sensitive than white paper. In 1839, the Rev. J. B. Reade was making pictures with the "solar microscope" † on paper sensitized with silver nitrate. To take advantage of Wedgwood's observation, Mr. Reade used all the white kid gloves the household authorities could spare, and, the supply falling far short of his requirements, thought he would try and "tan" paper. Accordingly

* The fact that paper treated with chromic acid had been sensitive to light was known long before Ponton published his discovery.

† The solar microscope was an instrument in principle like a magic lantern, arranged so that a beam of sunlight could pass through the microscope in an otherwise darkened room, and project a picture of the object on a small screen suitably placed.

AN ALPINE SKI-RUNNER

BY WARD MUIR

he treated paper with gallic acid, and found at once that he got greater sensitiveness. What he did not note, however, was that this action of the gallic acid was exercised during as well as after exposure, and that it was, in fact, a "development" of the latent image. Reade mentioned his discovery to Ross, the celebrated optician, who in turn told Talbot, in whose hands the observation of Reade rapidly became the "calotype" or "Talbotype" process. Paper in which silver iodide had been formed by alternate treatment with silver nitrate and potassium iodide, was washed over with a solution of silver nitrate and gallic and acetic acids. After this second application, it was highly sensitive, but soon spoilt. On exposure in the camera an image rapidly appeared, and was then developed up to full vigour by further treatment with the "gallo-nitrate of silver." A solution of common salt for fixing purposes was suggested by Talbot, but was seldom employed, hypo being already known in that capacity.

The same year that saw the patenting of "calotype" saw another patent granted, to Claudet, for the use of red or yellow light to illuminate the dark room, which hitherto had been lit only by very feeble artificial white light, such as is given by a candle some distance away from the sensitive substance.

Daguerreotype was largely practised for professional portraiture from 1840 to 1852 or 1853, while calotype became for a time quite the fashionable craze. Queen Victoria and Prince Albert had a studio and dark room at Windsor, and thousands of photographers took landscapes with quaint leather-hinged folding cameras, and exposures of anything up to an hour or more. With calotype, in spite of its slowness—to modern eyes—and its difficulties, good work was done; and its insensitiveness did not prevent its use for portraiture, although direct sunshine was generally used to cut down exposures as much as possible. Some of the work done in 1844 and 1845 by D. O. Hill is still in existence, and has pictorial quality which enables it to hold its own with work of the present day. The "waxed paper process," a later modification of calotype, was popular for landscape work as an amateur's process for a very long time.

While daguerreotype and calotype flourished, collodion was discovered by Prof. Schonbein of Basle, and seemed to

offer what photographers had been wanting—namely, a film which could be applied to glass and sensitized. Daguerreotypes could not be "printed;" while although this was possible with "calotypes," they gave prints with some degree of coarseness, owing to the fibre of the paper which formed the support of the negative. Scott Archer, in 1851, invented the "wet plate," or "wet collodion" process. A glass plate was coated with collodion containing metallic iodides, immersed in a solution of silver nitrate, exposed while still wet, developed with a solution of pyrogallic and acetic acids, and fixed in hypo. A negative so obtained gave results equal in fineness of definition to anything that can be got to-day, and the wet plate process, very slightly modified from the condition in which it left the hands of Archer, has been used right up to the present time for photo-mechanical work. It is now being supplanted by gelatine dry plates, specially made for "process" work.

The wet plate was vastly more sensitive than either the calotype or the daguerreotype, but only while it was wet. If dried, the silver nitrate solution crystallized in the film and spoilt it, or if it were washed out, most of the sensitiveness went with it. Various ingenious methods were devised to meet this difficulty, the most successful being the Taupenot, tannin, and collodio-albumen methods, but not till 1864 was an emulsion dry plate made. In that year Sayce and Bolton described how it was possible to make "collodion emulsion"—collodion containing silver bromide in suspension, which could be poured on to glass and allowed to dry. The plates so prepared would keep indefinitely. Collodio-bromide was never as sensitive as wet collodion, but it was fast enough, and with its other advantages was popular as an amateur's process. It is still made for certain special forms of process work. At one time it was very popular for lantern-slide making, yielding transparencies of great richness and brilliancy.

There was no great change in negative processes until the late "seventies," though investigation was constantly going on, and photographic bypaths were explored and opened up. For example, Poitevin, in 1855, used Mungo Ponton's discovery that gelatine treated with bichromate became insoluble in hot water after exposure to light, and succeeded in making prints

by means of it; but he failed to get half-tones, although blacks and whites were yielded readily enough. In 1858 Pouncy invented the process now known as gum-bichromate, though it dropped out of sight again for many years. Burnett, Blair, and Fargier improved upon Poitevin's attempts, until Joseph Wilson Swan, in 1864, patented the carbon process, which, with slight but valuable modifications introduced by Johnson in 1869 and Sawyer in 1874, is the process as we know it to-day. Amongst other inventions of Poitevin was the method now known as oil printing.

On another line, also, work was steadily progressing. Herschel, in 1842, published the fact that several iron salts were sensitive to light, and shortly afterwards based certain printing processes upon it. Some of these survive as the "blue printing" methods used by engineers and others for copying tracings; the others are obsolete. Hunt, in the fifties, attempted to turn the iron in the Herschel pictures into platinum, but failed to get a practical result, and it was left for W. Willis, in 1873, to patent a process, in which the image was composed, to all intents and purposes, of metallic platinum, and therefore was as permanent as could well be desired. This process he improved in 1878 and 1880, when platinotype as known to-day became an accomplished fact, though the prints had to be developed in a hot solution of oxalate, the "cold bath platinotype" not being introduced until 1892.

A discovery was made in 1873 by Prof. H. W. Vogel of Berlin, the full significance of which was not at first appreciated; in fact, it is only within recent years that its importance is being realized, and, what is more, utilized by photographers. We have seen that Scheele a hundred years before had noticed that all colours did not affect the sensitive substance equally, and that yellow, and especially red, seemed to have but little effect upon it. Of all colours yellow is the brightest to the eye, yet in a photograph yellow appeared quite dark, green appeared darker than it should do, and a pure red appeared black. Acting on earlier observations by Herschel and Draper, that colour sensitiveness of photographic plates and papers was dependent upon the absorption of coloured rays by the sensitive substance, Vogel found that by adding certain dyes to the sensitive plate, it could be made to respond to the colours to

which hitherto it had been insensitive. Thus he laid the foundation of orthochromatic photography, and cleared the ground for "three-colour" and other processes intended to give photographs in the colours of nature. The clue once provided, the action of thousands of dye-stuffs has since been investigated, and although nothing, so far, has been found which will make the sensitiveness of a plate to colours correspond with the sensitiveness of our eyes, it has been found possible to make plates sensitive to some extent to all colours, so that by using them with a coloured screen to cut off some of the rays to which the plate is disproportionately sensitive, we can obtain a close approximation to a true monochromatic rendering.

The wet collodion and the collodion emulsion processes were regarded as marvels of sensitiveness, "instantaneous" work was done with the former, and the latter was as convenient a tourist's method as photographers could then conceive. Attempts were made, however, to find some other and more convenient vehicle than collodion, which compelled the use of ether and alcohol as solvents, and gave a film which, if sensitive and structureless, was extremely tender and destroyed by a touch. Gelatine seemed to be what was wanted, and Maddox in 1871 succeeded in making negatives by a process very much like that of Sayce and Bolton, but substituting gelatine for collodion. It was imperfect, however, and offered no advantages as far as could then be seen. As collodion emulsion for coating plates had been put on the market, Kennett, in 1874, prepared gelatine "pellicle"—dried emulsion—which was soaked in water, dissolved by heat, and poured on the plate. The great merit of the gelatine process was discovered by Charles Bennett in 1878, when he found that by keeping the emulsion gently heated for some hours or even days, it attained a degree of sensitiveness so far in advance of the highest reached by the wet plate process, that most of its first users failed through their plates being fogged by the dark room lights, which for collodion had been safe enough. What Bennett did at a gentle heat in days, Mansfield and Bolton rendered possible in a few minutes by boiling, and Monckhoven without extra heat by the mere addition of ammonia. By 1880 gelatine dry plates were fairly on the market, exposures had

ON THE BANKS OF THE LEA

BY J. H. ANDERSON

been reduced to fractions of a second and modern photography had "arrived."

The eighties saw an immense growth both in commercial and in amateur photography. Swan showed that the same preparation that was applied to glass for negatives could be applied to paper for prints, giving us bromide paper. More recently Dr. Bakeland introduced a very slow emulsion paper of this kind, which could be worked by artificial light without a dark room at all. As "gaslight paper," or "developing paper," it has come to be very largely used, and is now rapidly supplanting "P.O.P." referred to below.

The original silver paper of Talbot underwent little modification except that by coating the paper with white of egg, a fine surface was given on which to form a picture, thus getting "albumenized paper," which held its own for nearly fifty years, and is responsible for most of the faded portraits in family albums.

Later on it was found that just as silver bromide could be "emulsified" in gelatine and applied to paper, so could silver chloride, and paper prepared with this and certain other silver salts was long supplied by Obernetter. The Ilford Company, in 1891, started its manufacture on a large scale under the name of P.O.P. (printing-out paper), and the impetus thus given to it soon sufficed to make albumenized paper almost a thing of the past.

One other development remains to be noted. George Eastman, an American plate-maker, early realized the commercial possibilities of a hand-camera provided with a roll of flexible sensitive material instead of glass, and sold the first Kodak, which used bromide paper, somewhere about 1886. Soon afterwards celluloid was substituted, and this was followed by "the daylight loading cartridge." In this advantage was taken of a device introduced nearly half a century before for the negative paper used by amateurs in those days. With the film or paper a strip of black paper was rolled, both longer and wider than the band of sensitive material. By this means it was possible to load and unload a camera with a roll of film in daylight. Beside the hand-camera, the most striking modern developments are the kinematograph and the various "screen-plate" methods of colour photography, of which the Lumiere "Autochrome" was the pioneer. These are dealt with later on.

The limits imposed by a work of this character prevent reference being made to many ingenious appliances and original methods worked out from time to time by inventors; and this sketch of the growth of photography has necessarily been limited to a demonstration of the way in which the methods most popular to-day have been evolved. Side by side with the evolution of processes there had gone on a perfecting of apparatus, in its way as remarkable, but to follow which would take too long. Cameras have altered less than might be supposed; the simplicity of their functions has not entailed any elaborate development of design. This is far from being the case with lenses, and it is no exaggeration, but almost an underestimate, to say that the anastigmat at the beginning of the twentieth century, though in a legitimate line of descent, is as far removed from the lenses available to Daguerre and Talbot in 1839 as the modern dry plate is from the processes of those pioneers. But an acquaintance with the history of the lens, though interesting, is not of much help towards its successful use, and we must forego even opening so large a subject, especially as to follow it up demands a familiarity with physical science not required by those who only utilize the tools which that knowledge places at their disposal. Let it suffice to say that the names of Petzval, Andrew and Thomas Ross, J. H. Dallmeyer, Steinheil, Abbe and Schott, Rudolph, Schroeder, Von Hough, Voigtlander, T. R. Dallmeyer, Aldis and Dennis Taylor form as brilliant a list as those of their fellow-workers whose labours have been set forth in this sketch.

So has photography grown, sometimes slowly, sometimes by leaps and bounds, but every step that has been taken has started from some earlier work, and in tracing the progress backwards, we are led further and further until the trail is lost in the darkness of antiquity. It is no one man's discovery, nor yet that of ten nor of a hundred men, but the product of many brains and many years. The greatest steps of all were taken, undoubtedly, by Wedgwood and Daguerre, but Wedgwood's did not lead him to a practical process, and if Daguerre's took him far, it took him at right angles to the main road that has come down to our own time. To show to what that road has led, is the purpose of what follows.

CHAPTER II

THE CAMERA

The camera and lens separately selected—The camera in outline—Rigidity the first essential—Testing for light-tightness—Ghosts—Stray light in the camera—The rising, falling, and cross front—The different forms of rising front compared—The camera extension—Focussing methods—The swing back—The reversing back—The ground glass—Dark slides—Carriers—Metal dark slides—The Mackenzie-Wishart slide—Magazines and changing boxes—Film-carriers—The Premo Film Pack—Roll holders—Stands—Studio stands—Tripods—Sizes of plates—Choosing a camera—The degree of extension needed—Large direct work *v.* small work enlarged—Patterns of cameras—Dust in the camera—Care of the camera.

THE chief instrument of the photographer consists of two parts, the camera and the lens. These two parts are so distinct, that in many cases the makers of lenses do not make cameras, and *vice versâ;* and in all except the cheaper patterns of hand-camera and stand-camera "complete sets," the camera and lens are selected separately, and the lens attached to the camera is chosen by the purchaser.

The camera performs three functions—it holds the lens, it holds the sensitive plate in the proper position with regard to the lens, and it excludes all light from the plate except that which has come through the lens. The part of the camera holding the lens is always referred to as the front, but the term "back" is loosely used, either for the entire opposite end of the camera to the front, or for a detachable receptacle in which the plates, usually two, are carried. It wants no very elaborate mechanism to perform these functions; and the photographic camera, for the results it yields, is one of the most simple pieces of apparatus that can be imagined. The idea which so many people entertain, that a good photograph is necessarily the outcome of a "good" camera, or that it is in any way possible to judge of the excellence of the camera by looking at pictures

taken with it, is altogether mistaken. Some of the qualities of the lens may possibly be revealed in the work done with it, but then only to an expert, as we shall see later on; but of the camera, none. The great merits of a good camera are the convenience with which it can be used, and the way in which it can be adjusted to meet the special requirements of each particular case.

The first essential is that it shall hold both lens and plate firmly in the desired position. When the camera is extended as it would be for taking a photograph, and the top of the front is held in one hand and the top of the back in the other, no looseness should be felt between them. There should be no play at all, when the stays provided have been put into position or have been screwed up.

Then, of course, it should be light-tight. The effects of light leaking into a camera are twofold. The common result is a general fogginess or greyness of the negative, except where the plate has been protected by the edges of the dark slide. This is the case when the light does not shine straight on to the plate from one small opening, but is scattered about the interior of the camera by reflection. A less frequent result, but still one which is responsible for some of the most absurd fancies, is that of a "ghost." A typical case of this sort was submitted to the Royal Photographic Society many years ago. A photograph of a snow-covered scene in the Himalayas bore on it the ghostly images of two coolies, through whose bodies the scenery was clearly visible. It was suggested at the time that in the locality of the Mahatmas some supernatural forces might not improbably be at work; but the real cause of the figures was plain enough. The camera having been set up, the shutter of the slide was drawn a short time before the exposure was made. A pin-hole in the bellows or in the camera front threw a pin-hole picture of the two men on the plate, and silhouetted as they were against the white snow, it would not require a very long exposure for a distinct image to be recorded. They may have been at the side of the camera, or in front. If the latter, they were got out of the way before the real exposure was made, which by making some of the landscape visible through the image of their bodies would give rise to the ghostly effect. These ghosts are so often met with

that on an average some dozen cases are brought to the notice of the author in twelve months, due undoubtedly to minute holes in some part of the camera.

There is also stray light at times which has got in by the orthodox entrance, the lens. This has been scattered by reflection from the sides of the camera, and even from the plate itself. More trouble has arisen in recent years than formerly on this score, because modern lenses, as a rule, include a much wider angle of light. The result is that not only is the plate lit, but much light shines on the bellows of the camera, and from them is reflected on to the plate. The better the lens, the more likely is the trouble; with reflector cameras, where the very finest of lenses are generally used, it may be very rife. What is worse, it cannot be prevented. It can only be minimized. To do this, the interior of the camera is painted over with a dull black paint, so that as much of the light is absorbed and as little is reflected as possible. If dust is allowed to accumulate on the inside of the camera, much of the good done by the blackening is lost, as the dust is light coloured and reflective.

Only the very simplest forms of camera have the relative positions of the lens and plate fixed once for all; in most patterns they are capable of adjustment in several ways. The first is by means of the rising, falling, and cross front. The most useful adjustment of all is the rising front, by which, still keeping the front of the camera parallel with the plate, the lens can be raised so that its centre is no longer opposite the centre, but may be as high as or even higher than the top edge of the plate. For reasons which will be discussed later on, the back of the camera must usually be kept strictly upright. When photographing a high building from a standpoint that is comparatively near, with the lens in the centre of the plate, we may find nearly half the picture is nothing but foreground, while most of the building is not on the plate at all. By raising the lens, as is done with the rising front, still keeping the camera level and the back upright, we shall find that more of the building and less of the foreground are on the plate, until a point may be reached at which the entire building is in the picture. For outdoor photography, where nearly every subject is bounded by the ground only a few feet below the camera,

while extending indefinitely in the other direction, the rising front is so constantly of service, that it would be better to have the lens permanently fixed above the centre of the plate, so that we always used a certain amount of rise, than to have it in the centre, so that we could never have any at all. The falling front is for employment under precisely opposite circumstances, but is very seldom wanted. Many cameras are fitted with cross fronts, by which the lens can be shifted from side to side. In the cameras which only take the plate one way, and have to be turned bodily on their side to take it the other, this cross-front movement is important, because when the camera is turned it becomes a rising and falling front. It is serviceable also when a stereoscopic pair of pictures is required, on a half plate for example. A partition is fixed in the centre of the camera, and the lens slid sideways until it is opposite one half of the plate to give the first picture, and then slid across to the other side for the other. Apart from this the cross front is not of much use. It is convenient at times, when, after much elaborate arrangement for a difficult subject, everything is right except the position of the picture on the plate, which is just a trifle too much to one side or the other. The cross front can correct this without interfering with the other arrangements. But this is only a makeshift, and should not be used except to a very trifling extent, or it may introduce other troubles, from alteration in the perspective.

The movement next in importance is that which allows us to alter the distance between the lens and the plate, for focussing purposes, or to accommodate different lenses. The base of the camera being fixed, this can be done by moving on it either the front carrying the lens, the back carrying the focussing screen and plate, or both. Studio cameras intended to use heavy lenses generally focus by sliding the back only. This is also the most convenient pattern for copying. Portrait lenses are generally mounted in a tube with a rack and pinion, so that after focussing approximately by sliding the back of the camera, fine focussing is done by racking the lens in or out.

In some hand-cameras focussing is effected in a somewhat similar manner. The lens mount has a very coarse screw-thread on it, and runs in a jacket with a similar thread. The lens is then drawn in or out by merely turning it in its jacket.

TIVOLI

BY JOHN H. GEAR

For general purposes, and especially in most forms of landscape and hand-camera, it is the front that moves, and in the most adaptable of all both back and front can be moved. Whichever it is that slides, it ought to do so smoothly and evenly with no tendency to wobble sideways, and with as little play as can be expected from the kind of workmanship paid for.

We have already referred to the importance of keeping the back of the camera vertical. In order to do so when the camera itself is tipped up, as in the attempt to photograph a high building, many cameras are provided with a "swing-back;" that is to say, the back to which the bellows are attached is

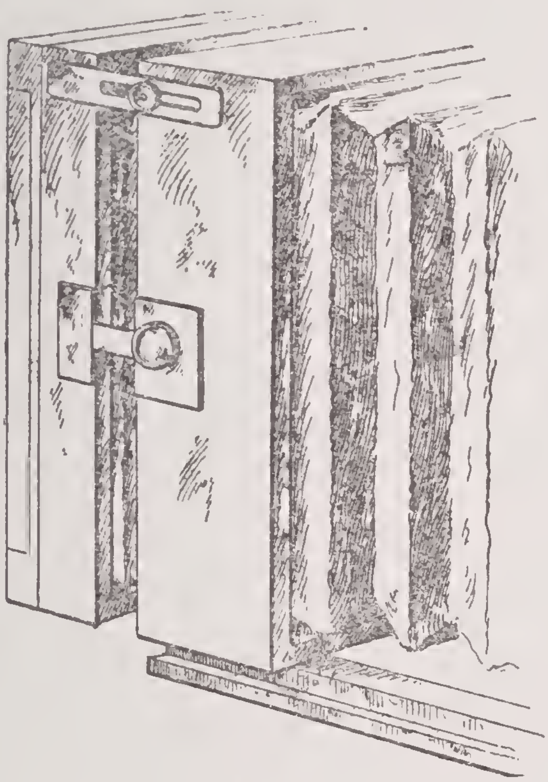


Fig. 4.

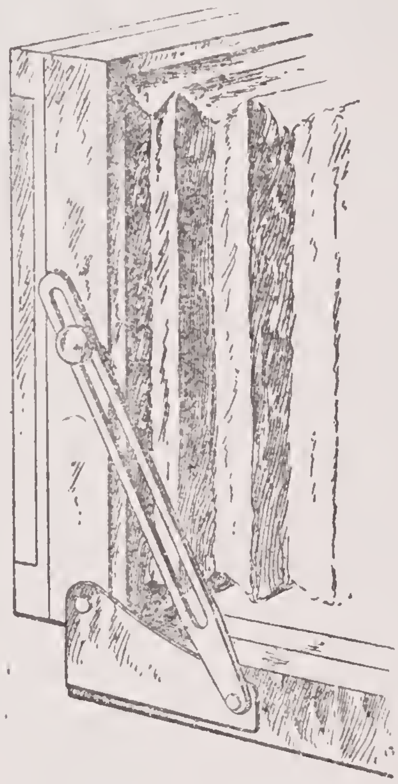


Fig. 5.

not fastened directly to the baseboard, but swings on trunnions within a frame (Fig. 4), or else is pivotted on its bottom edge and fastened where desired by means of a strut (Fig. 5). The former method is easier to use, but there are constructional advantages—the camera is simpler—when the latter is employed, and the difference is not enough to trouble about A camera that has to be turned bodily over to take a picture the other way of the plate should have a back which swings horizontally as well as vertically, as the one becomes the other when the camera is turned. If the camera has a "reversing back" there is no need to turn it, and therefore no need for the horizontal swing. It is sometimes said to be useful in

focussing, allowing one edge of the plate to be nearer to the lens than the other, when photographing a long row of objects that reach from the camera; and the purists point out that this introduces distortion or makes the perspective false, and condemn the practice accordingly. There seems to be no real reason why it should not be employed, when absolute literal truth is not the immediate object of the photograph—and this must be the case in ninety-nine per cent. of the exposures made at the very least. Our objection is rather that it is so seldom required as to be a needless complication.

Most stand-cameras are now made square at the back, and are fitted with a reversing back. In architectural work, particularly, it is convenient to be able to put the reversing back into the camera in any one of the four possible positions, because it often happens that every inch of room behind the camera is valuable. We have known a lot of time wasted in setting up a camera and getting everything ready to take the picture, only to find that a wall or pillar or some similar obstacle absolutely prevented the shutter of the dark slide from being drawn. If the back could have been turned half round, so that the slide was drawn out from the other side, this trouble would have been prevented.

The focussing screen is generally a piece of ground glass, though in some small cameras ground celluloid is used for lightness and to prevent risk of breakage. In all other respects glass is much to be preferred, and in everything above quarter-plate size is essential. It should be perfectly flat and very finely ground. Some cameras are fitted with such coarse screens that anything like fine focussing is impossible. Such a screen is best taken out and replaced by something better. Special finely ground flat glass is now sold for this particular purpose.

The American term "plate holder" is distinctly preferable to "dark slide," the name generally given in this country to the appliance by which the plate is carried about protected absolutely from light except at the moment of exposure. The early cameras made to take wet plates were usually fitted with a single dark slide to hold one plate only. Instead of having a reversing back, they had a square dark slide in which the plate could be put either vertically or horizontally. A few

such instruments may still be in use in old-fashioned studios, and a very similar, but more elaborate, dark slide is employed in process cameras ; but for all ordinary purposes the old single wet-plate slide has been supplanted by the "double dark slide" or "double back."

Double dark slides are generally made of one of two different patterns, known respectively as "book form" and "solid." The former are the more elaborate and costly ; the latter are cheaper to make, and take up less room when opened—a consideration where the dark room is small.

The regulation number of double dark slides per camera is three, and in comparing the prices of different instruments, it is well to make sure that each price includes the same number of slides. With small cameras, it is often very convenient to have more than three ; as many as half a dozen, in fact, are useful. But dark slides, if the most convenient in use, are an extremely bulky way of carrying plates, and when many exposures are required some other means should be employed. Cases lined with flannel and made to hold one dark slide each can be purchased, and save scratching and other injury to a nicely finished slide, as well as acting as an additional safeguard against light-fog ; although the dark slide that needs this must be a very bad one, and a snare. Carriers or inner frames are supplied, which fit in the slides in the places occupied by the plates, and so enable a small plate to be used in place of a large one. These carriers can be got in nests fitting one inside the other, and taking a whole series of sizes.

Of late years there has been something like a revival of the single slide, several very compact forms having made their appearance, some of which, made of metal, are not much larger than the plates they enclose. The Mackenzie-Wishart plate holder is a single wooden slide, the plate being carried in a particular form of envelope, of celluloid and light-proof cloth. One of these being shut up in the slide, the act of drawing the shutter opens the envelope and exposes the plate to the camera. Replacing the shutter closes the envelope again, and it can then be taken out of the dark slide in daylight, and a fresh plate in another envelope inserted. This arrangement is extremely compact, and, if used with due care, is effective.

There is no limit to the number of envelopes that can be used, one single slide serving for all of them.

Ingenuity has been lavished on plate-holding devices, but to this day the dark slide, altered very little in design since the introduction of the dry plate, holds its own undisputed in larger sizes, and equalled, but not excelled, even for small plates. The magazine, usually holding a dozen plates, although excellent for $3\frac{1}{2}$ by $2\frac{1}{2}$, quarter-plates, and possibly postcard sizes, is not very suitable for larger plates, and even for small has drawbacks of its own. The failure of a dark slide from any cause only means that one plate or at the most two cannot be used; but if the more elaborate changing mechanism of a magazine jams, the photographer relying on it finds his work completely stopped. For this reason, and because of its greater complication, nothing but the best of magazines is to be recommended. A cheap form of dark slide, if not elaborately finished, may nevertheless be perfectly efficient; but a cheap magazine is to be shunned. The only form the author can recommend is the "N. & G.," in which the plates are carried in sheaths, twelve plates or twenty-four films in each box. The top of the box is a soft leather bag, into which the plate is raised by drawing up a "lifter." The plate in its sheath is then caught hold of through the bag, and is pushed down a slot into the front of the box, ready to receive the image as soon as the shutter is drawn. When it has been exposed, the next plate is raised, picked up, and pushed down, sliding in front of the first and pushing it back in so doing. This changing box is very efficient in small sizes, but has certain inconveniences. The exposed plates being in front of the others, and the box being loaded and emptied from the back, it is necessary to take out all the plates to get at the exposed plates for development. (The "Adams" magazine avoids this.) Moreover, the box must be handled carefully, and the sheaths must on no account be allowed to get bent, or they may jam and render the box useless until attended to in a dark room. In handling the plates, it must be done so that there is no risk of a sharp corner of glass piercing the leather bag, and the plate should be held sloping with its top away from the front of the box to avoid rubbing anything against the face of the plate. There are a number of devices for carrying plates

in the camera itself, but these all apply to hand-cameras only.

Those who use films instead of plates find the dark slide or changing-box problem much easier. In the first place, all apparatus without exception which will take glass plates will take cut films. In some cases no additional apparatus at all is required; in others some form of carrier or sheath must be used, applied to which the cut film becomes the same size as a plate and as stiff, and is treated throughout in the same way.

The simplest form of carrier is a thin metal frame in which the film slips, a black card of the requisite thickness sliding in also and holding it in position. In another form the card is dispensed with, the sheath being simply a thin sheet of metal, with corrugations to stiffen it and give it the requisite thickness, and with its edges turned over to form grooves to hold the film. In large sizes, cut films mean a very great decrease in weight, and they can be used in dark slides without any carrier at all. The film is placed in the grooves just like a plate, and a piece of stout card the same size is placed on it, and the dark slide closed. The spring in the centre of the slide in such a case must be removed, or it will make the middle of the film bulge out. Another effective plan, which does away with the need of removing the spring, is to insert behind the film a light wooden frame, like a plate-carrier but without any catches. If the spring does not project beyond the thickness of the frame, it then does no harm, the author has used 12 × 10 cut films in this way, without any sheath, quite successfully. If negative paper or bromide paper of large size is to be used, it has not the stiffness of a cut film, and may be attached by gummed paper strips to the wooden frame, to avoid any risk of it bulging into the camera.

But all these take no advantage of the great merit of the film—its flexibility. It is only when we come to the roll holder and the "film pack" that the celluloid film shows how readily it adapts itself to the requirements of the photographer, and especially to arrangements for daylight loading, dispensing entirely with all need of a dark room for filling or emptying slides or cameras, or indeed for developing. The best device for using cut films is that known as the film pack, the

invention of G. E. Thornton and now produced by several makers. The film pack consists of two parts—the holder, which may be separate for insertion like a dark slide into the camera, or may be built into the camera itself, as is the case in some forms of hand-camera; and the film pack, which is sold ready loaded with a dozen films. Each film is attached to one end of a long strip of black paper, which is led round a roller at one end of the pack of films, up behind them, and ends in a numbered tab which hangs loose outside the pack. The film pack is put into its holder in daylight, exactly as bought, a label is broken, the holder is closed up, and on pulling the first tab, the first film is exposed in the holder ready to receive the picture. On pulling the next tab, the first film is drawn round the roller to the back, and the second is ready for exposure, and so on through the whole dozen. When the last tab is pulled, the holder may be opened and the pack taken out in daylight, and a new pack substituted, and so on.

A film pack may be opened, and one or more films taken out for development, and the pack closed up again for exposure of the rest; but, though possible, it is much better to avoid this all one can. The pack, when all are exposed, is easily opened, the films taken out for development, and the pack itself thrown away. As each film is carried round the roller to the back, there is a chance that its sensitive surface may get rubbed or scratched, the changing should therefore be done gently. Some workers seem particularly unfortunate in getting these scratches, others never or hardly ever meet with them; so that it looks as if they were due largely, if not entirely, to the personal factor. The author has exposed hundreds of films in the film pack, without more scratches than occur in the most perfect form of plate magazine, certainly without anything to counterbalance the very great advantage of this ingenious device. Its most serious drawback is a defect of its qualities. The very ease and simplicity of the changing, and the fact that the film packs are light, portable, and can be replaced in full daylight, are a great temptation to make more exposures than would be the case were the changing less facile.

For those who use roll film in lengths there is the roll holder. In spite of the fact that more roll film is used to-day

than ever, the roll holder, *qua* roll holder, is almost obsolete. The reason for this is that roll film is almost exclusively used in hand-cameras, or at least in cameras specially constructed to take the film. In other words, the roll holder is very seldom a separate fitting, but is usually part and parcel of the camera itself, and not separable from it. Separate roll holders can be bought, however, which can be used in place of dark slides, it being necessary to state, when ordering spools of film for them, that they are required for a roll holder.

Beyond postcard size ($5\frac{1}{2} \times 3\frac{1}{4}$) the conveniences of roll film are to a great extent lost, as it is not likely with large sizes that so many exposures will be required between each changing. In the larger sizes there is the difficulty of keeping the thin flexible film flat. Even with postcard films this is an important matter when modern high-class lenses are used, with which a very slight degree of unevenness in the plate or film means a loss of some of the advantages of the lens. The "Eastman Portrait Film" is a flat cut-film of stouter substance, which is not open to this objection.

Camera stands may be divided into two classes, tripod and studio. The amateur as a general rule is content with a tripod stand, but for portraiture, for photographing such subjects as flowers, fruit, natural history specimens, and for copying—in short, for general work indoors, a studio stand, even if quite simple and with few adjustments, will be found a very real convenience. It is a great nuisance to find, when all has been arranged, that the camera ought to be just an inch or two nearer to the subject, or *vice versâ,* and that in consequence of a tripod being used, all the adjusting and levelling has to be done over again. For those who do not wish to have two stands, but yet appreciate the convenience of the stand on casters, there is an ingenious appliance called the "Folding tripod adapter," a three-armed wooden frame running on casters, with a place at the extremity of each arm to receive the tripod foot. This gives some of the advantages of the studio stand.

The tripod is the popular form of stand, and combines a maximum of rigidity with a minimum of weight. The weak point in most tripods is the attachment of the legs to the

tripod head, and when a stand is shaky, it will nearly always be found that the source of the trouble is at the top. The firmest tripod the author has ever used is the "Ashford," but this is a comparatively heavy pattern and in its most rigid form is only twofold, though a threefold pattern is made. Anything less than threefold is inconveniently long at times, and if the outfit is to be carried on a cycle a fourfold tripod is a convenience. However many the joints in the legs, one of them should be a sliding one, clamping with a screw. Other things being equal, the bigger the top the firmer the stand. Some tripods with very small tops, even if firm to start with, soon get so shaky that they are worse than useless. Tripod stands are sometimes made of metal, steel or aluminium usually. Each leg is tubular and telescopic. But such stands involve the risk that a single blow may make the whole stand useless; so that, except in very special circumstances, legs made of good ash are to be preferred.

If the camera is to be used exclusively for work on the tripod, instead of having a tripod stand with a separate head, a "turn table" may be let into the baseboard of the camera, to which the tripod legs are directly attached. There is a gain both in firmness and in portability by this means. All things considered, when the photographer has only one camera it is better to have the head separate altogether.

Since the war, an agreement has been reached amongst camera makers to specialise on four sizes only for small plate cameras, so as to reduce the number of odd sizes which threatened to become excessive. This will ultimately react beneficially on the plate trade, and by limiting the number of sizes which a dealer need stock, will increase the likelihood of his supplies being fresh. The four sizes agreed upon are:—

No. 0.—$4\frac{1}{2} \times 6\frac{1}{2}$ c.m.—in place of a multitude of small sizes.
No. 1.—$6\frac{1}{2} \times 9$ c.m.—$3\frac{1}{2} \times 2\frac{1}{2}$ in. and 6×9.
No. 4.—8×12 c.m.—quarter plate and 9×12.
No. 8.—10×15 c.m.—$5\frac{1}{2} \times 3\frac{1}{2}$, $5\frac{1}{2} \times 3\frac{1}{4}$ and 9×14 c.m.

The numbers with which the four sizes are prefaced are part of a series which at the same time it has been agreed to adopt, to designate the various standard sizes, so as to do away with the necessity of giving the actual dimensions. The others in the

THE WHITE SAIL

BY ALEXANDER KEIGHLEY

series are $3\frac{1}{2} \times 2\frac{1}{2}$ in. (No. 2), $4\frac{1}{4} \times 3\frac{1}{4}$ in. (No. 3), 9×12 c.m. (No. 5), 5×4 in. (No. 6), $5\frac{1}{2} \times 3\frac{1}{2}$ in. (No. 7), and $6\frac{1}{2} \times 4\frac{3}{4}$ in. (No. 9). Thus a camera described as a "Klito No. 3" will be known to take quarter-plates, and a "Cameo No. 1" plates $6\frac{1}{2} \times 9$ c.m., and so on.

This change is a direct outcome of the modern tendency to use smaller and smaller sizes, relying on enlarging to get bigger pictures when required. At one time, quarter-plate was the smallest size likely to be met with. There are still more quarter-plate cameras in use than any other size; but $3\frac{1}{2} \times 2\frac{1}{2}$ is growing rapidly into favour; though to judge from what has just been written on the standardisation of sizes, both quarter-plate (No. 3) and $3\frac{1}{2} \times 2\frac{1}{2}$ in. (No. 2) are likely to be replaced by $6\frac{1}{2} \times 9$ c.m. (No. 1) and 8×12 c.m. (No. 4) respectively.

In choosing a size it should not be forgotten that the definition possible with small plates is better than is practicable with large ones. This opens up the question, Is it better to take a large photograph direct, or to take a small one and enlarge it? When the camera is to be carried about, the small negative and enlarging offer many advantages, while for studio and similar work direct photography on large plates is preferable. The author has used a quarter-plate camera for years for nearly every purpose, making direct enlargements on bromide paper or enlarged negatives when bigger pictures are wanted. There should be little in an enlargement 15×12 inches, if it is on rough bromide paper, to show whether it is made by contact from a negative that size or enlarged from a quarter plate. Framed and hanging up, no one should detect any lack of detail from the fact that it was enlarged.

If a stand camera is to be used, a half-plate is as large as can be carried about far without discomfort. Half-plate has this against it—that prints that size are not very imposing, while enlarging means that daylight must be used, or else a very cumbersome condenser, 8 inches in diameter at least, must be employed. For these reasons, if the camera is not to be carried about very much, whole plate is a better size. Whole-plate prints are quite capable of holding their own at an exhibition, and the apparatus is still not unwieldy. 10×8 is not very popular, being considerably heavier and more costly

than whole plate, without any very apparent gain in the importance of the prints, the next notable size to whole plate being 12 × 10. This gives a fine large print, but is not very manageable, and is certainly not portable.

In selecting a stand camera, if for use indoors, and weight is not very important, the square bellows pattern, with folding tailboard, the front fixed rigidly at right angles to the baseboard, the back drawing out and clamping by means of two screws on the top of it, is old fashioned, but unsurpassed for rigidity, strength, and general convenience. Except to carry about, this form can hardly be improved upon. A half-plate camera of this type should have an extension of at least 16 inches from focussing screen to front; a whole plate should extend 22 inches. It is heavy, however, and does not extend so far as one of the lighter forms of "landscape" camera.

The most popular form of stand camera, one that has come to be more or less a standard pattern, is the taper bellows form, extending back and front (Fig. 6). If properly made, it is convenient to use, light to carry, and remarkably rigid. We have already seen some of the tests to which it should be put; but if it is got from a reliable dealer, there ought to be no trouble either from lack of register, want of rigidity, or light leakage.

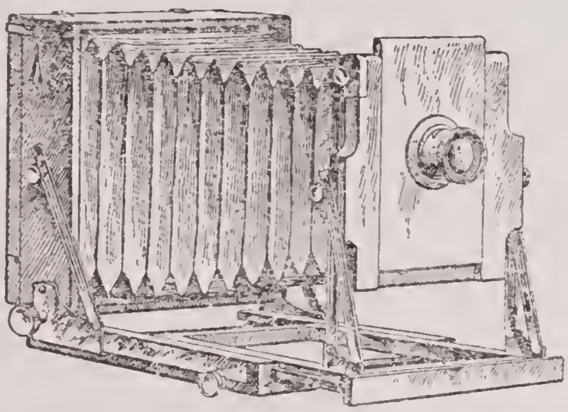


FIG. 6.

It should either have a swing back or else a great rise of the front, as in the Sanderson. If it has not this rise, which should be sufficient to bring the middle of the lens opposite the top of the plate when this is vertical, and even if it has this, unless a very high-class lens is to be used, a swing back is useful. A half-plate camera of this type should extend 18 inches from focussing screen to front, or if of "triple extension" it should extend to 22 inches.

Three double dark slides should form part of the outfit, and a leather case, to hold camera, slides, tripod head, focussing cloth, and lens, is certainly desirable. Waterproof canvas cases are supplied for this purpose, but they do not protect the camera

so efficiently, nor are they so cheap in the long run, for a good leather case will outlast three or four of them. The camera when not in use should be put away in its case, and kept in a dry place. If it gets damp it may work stiffly, or even refuse to work at all. Dust inside it is more than untidy; it is harmful. Camera and dark slides should therefore be kept clean inside and out. Inside, dust causes minute spots which appear black on the prints; outside, it gets carried into the camera on the slide, wiped off on to the inside when the shutter is drawn, and so causes trouble. Sliding parts, where wood moves on wood or on metal, must not be greased, but may be lubricated, if they work hard, with a little fine black lead applied with the finger. The whole of the inside of camera and dark slides should be blackened and kept black. Matt black varnish is sold for the purpose, and a drop may be applied to any bright parts. The spring in the dark slides, where it touches the centre of the plate, wears bright in time, and we have seen very conspicuous black marks on negatives caused by nothing more than the reflection from it. A morsel of black court plaster will stop up a pinhole in the bellows. Properly taken care of, the camera should last out the photographer himself, and should not perceptibly deteriorate in efficiency, if its looks get a little the worse with wear. But this chapter is best finished, as begun, with a reminder that the quality of the work in no sense depends on the quality of the camera. The advantage a good instrument offers over a bad one is very great, immeasurable almost, but it lies entirely in convenience and comfort in use, and in adaptability to varying conditions of work; and so long as it can be made to keep the light out, as fine photographs can be made with a packing case as with the most expensive instrument ever constructed.

CHAPTER III

THE LENS IN PRINCIPLE

The myth of the wonderful lens—Fancy prices for lenses—The description of lenses—Focus and its measurement—Principal focus—Back focus—The stop—Systems of marking stops—Stops and exposure—Effective aperture—Selecting a lens—Defects—Striæ—Centring—Covering and defining power—Curvature of the field—Astigmatism—Curvilinear distortion—Spherical aberration—Flare spot—Achromatism—The fallacy of examples of work.

IT marks one stage further in photographic knowledge when a person says of a photograph, "That must have been taken with a wonderfully fine lens," instead of attributing the excellence of the product to the camera. Yet as in the case of the camera, so with regard to the lens, it is not possible, without knowing something of the conditions under which the photographer has to work, to say whether the lens was a magnificent instrument, or one of the most rubbishy and worthless character. This is not to suggest that there is no practical difference between them, or that a fine lens is not worth all the money charged for it, but only to say that the good qualities of a lens are not superficial ones, and that it takes a knowledge of photography to appreciate the excellence of the lens, and a good deal more than a knowledge of photography to make a critical examination of it, and to ascertain how close it comes to the ideal instrument.

There is another common misapprehension that it is well to remove before going any further, and that is one which has been called "the myth of the wonderful lens." In the dark ages of photography—thirty years ago at the least—more was heard about the superlative qualities of some particular instrument or other than is the case to-day, and there is no doubt that in some cases there was just this foundation for the myth, that the lenses of the same type and by the same maker

often differed amongst themselves very considerably. With one or two exceptions, the lenses were made and tested by rule-of-thumb methods, which perhaps were all that were necessary at the time, but which made possible considerable difference in the qualities of different instruments allowed to go out into the market. The great improvements in lens design which have taken place in the last few years have made such methods of manufacture obsolete, or nearly so, and the makers have been obliged to employ refinements in manufacturing and testing which have done away with most of the old element of chance. One thing now is quite certain, and that is that in buying a modern lens by a reputable maker, one particular instrument of the type is practically as good as another, and all are far superior to the best productions of twenty or thirty years ago. We can be sure that if a photographer gets some supremely fine results in the way of definition, he does so, not by the occult properties possessed by the particular lens he is using and not shared by others of its make and class, but by the care and skill with which he employs it, and the favourable conditions under which he is working.

Several years ago the apparatus of a well-known amateur photographer who had won many medals for his work, was put up to auction, and, to the amusement of those who knew better, the lenses he possessed—and he had a good few of them—fetched considerably higher prices than new lenses of exactly the same sort and by the same maker could be bought for. It has not transpired that the work they have since done has been so successful, and the whole thing was a good example of the mistaken notions which prevail as to the true causes of photographic success.

A lens is generally described as being of such and such "focus," working at such and such an aperture, and covering such and such a plate. The last term explains itself; the focus and aperture may need a word or two.

The "focus" of a lens, as that term is generally understood, is the distance from the plate or ground glass to the lens, when it is focussed on an object at such a distance that everything beyond it is also in focus. The measurement may be made to the diaphragm of a double lens or to the glass of a single lens, and will then in most cases be approximately correct. Or we

may focus sharply some object so that its image on the screen is exactly the same size as the original; the lens will then be found to be equidistant from the plate and from the object, and the total distance of the image from the object is then four times its focus. Further refinements are not needed in practical work.

The stops are never described by their actual dimensions, but by the relationship between the focus of the lens and the diameter of the stop. This is generally expressed as a fraction, F (the numerator) standing for the focus, and the number of times the diameter of the stop is contained in it being the denominator. Thus a stop 1 inch diameter, used with a lens of 8 inches focus, would be described as F/8; this expression is generally referred to as the "F number."

With a great many lenses the largest stop which is fitted has a diameter equal to one-eighth of the focus of the lens; it is known, therefore, as F/8. The next size smaller to require twice the exposure is F/11·3, the next F/16, the next F/22·6, the next F/32, the next F/45, the next F/64. Beyond this very few lenses go; in fact, few go as far as F/64 now, although in the old rapid rectilinears this was always the smallest stop, and gave its name to a class of photographers who were noted for their fondness for the utmost definition, only obtained in those days by much stopping down; hence the term "F/64 men" applied to these enthusiasts. Portrait lenses work at F/4 or larger, and the series in their case becomes F/4, F/5·6, F/8, and so on as above. The competition to make lenses with as large apertures as possible has led to the manufacture of many, the largest stops for which are of odd sizes such as F/6·5, F/6·7, F/7, F/7·7, and so on. With these, as a rule, the custom of making each stop require twice the exposure of the preceding one does not hold good with the two largest openings; it is found most convenient for the largest opening to be whatever is the maximum working aperture, and the next to be F/8, after which the exposures double, as usual.

This arrangement makes it very easy for the photographer to go from one lens to another without getting wrong with his exposures. He knows, for example, that whatever lenses he be using, however big or however small, so long as he uses each with its stop marked F/8, the exposure with every lens will be the same. A word of caution is necessary here. The exposure

is only the same so long as the lens is being used at or near its principal focus. This is the case in most landscape and hand-camera work; it is not so true when we come to interiors and portraits; while in copying, if unintelligently applied, it would lead us altogether astray. For example, when copying the same size, the plate is distant from the lens twice the focal length of the latter; the stop, therefore, which the optician has marked F/8 is not for the time being one-eighth the focus, but one-sixteenth, and the exposure required is therefore four times as long. There are tables showing how, in copying, the extension of the camera affects the nominal value of the stop, and in doing work of this kind these tables should be consulted. For portrait work, interiors, and so on, the difference, though at times perceptible, is not great enough to introduce any serious difficulty, or to lead the photographer astray; though if his exposure errs in the direction of insufficiency, this will help to make matters worse.

There are other ways of marking stops besides that of giving their "F values." The U.S., or "Uniform System," was put forward by the Royal Photographic Society many years ago, but was not received with any enthusiasm. At length, after many years, some of the most popular cameras had their lenses marked in this way—many Kodaks, for instance, were graduated on the U.S. The Society then, rather perversely, withdrew its recommendation; but just as its advocacy had no perceptible effect on the adoption of the method, its withdrawal does not appear to have influenced its popularity.

The U.S. system starts with F/4, which at the time of its introduction was the speed of most portrait lenses. F/4 is known then as 1; F/5·6, requiring twice the exposure of F/4, is called 2; and F/8, requiring twice that, is U.S. 4. The others are as follows: F/11·3 = U.S. 8, F/16 = U.S. 16, F/22·6 = U.S. 32, F/32 = U.S. 64, F/45 = U.S. 128, and F/64 = U.S. 256. The merit of these numbers is that they express directly the relative exposures which the different stops require. Thus we know that with F/64 (U.S. 256) we must give 256 times as long as with F/4 (U.S. 1). In actual practice, however, there is little or no advantage, as the simple relationship expressed by saying that each stop requires twice or half the exposure required by its neighbours, respectively,

answers all requirements of the photographer. It may be useful as an aid to memory if we point out that F/16 is U.S. 16, and that the other U.S. numbers in order are each double or half the preceding number.

There are several other systems of marking stops; the simplest, when one iris diaphragm is to be used with two or more lenses, is to have the aperture of the diaphragm and the focus of the lens marked on them in millimetres; the F/-number is found by dividing one by the other.

While it takes a skilful optician to test a lens exhaustively, the user can make a trial for himself which will at least show him some of its capabilities. And first a word of caution about appearances. Some parts of the best modern lenses are made of optical glass of a particular kind, one of whose peculiarities is that it is impossible to secure it quite free from minute bubbles. On looking through one of these lenses the bubbles, in all probability, will be the first things seen, and it may be supposed that they are defects. Of course it would be better if they could be got rid of without impairing any of the other qualities of the instrument; but as they cannot, and as the damage which they do to the defining power of the lens is quite inappreciable, the photographer must just put up with them. If he means to avoid them he must get an inferior lens made of glasses in which they are avoidable.

The most serious defect which a lens can possess, which a casual examination will reveal, is the presence of "striæ" in the glass. These are little lumps or masses of uneven density. Perhaps the best explanation is to compare them with the striæ which are seen when a strong solution of hypo is mixed with water. They should always be looked for when buying a lens—just as when, negotiating for a horse, it should be noted that he has four legs—but they certainly should not be found. Striæ are seen by looking through the lens, holding it a few inches away from the eyes and near some printed matter.

The next thing to note is that the whole of the interior of the metal mount of the lens has been treated with some dead black, so that, could the eye be put at any position occupied by the glasses of the lens, or at any position inside the camera, no particle of bright metal could be seen.

The most beautifully designed and finished lens ever made

could be completely ruined by being put up badly in its mount. The different curves to which its glasses are ground are all parts of spheres, and the centre of every one of these spheres must lie upon the imaginary line running right through the middle of the lens, and called its axis. If this is not the case, if the lens, in other words, is not properly centred, it is worse than useless. The centring is all the more important to the purchaser, because apart from the reputation of the lens maker, there is always a possibility that the lens may have had some mechanical injury since it left his hands which has affected the centring. This is easily examined. If we hold up a lens a foot or two from the eye, and look through it at a candle-flame 10 or 15 feet away, by twisting the lens slightly out of the straight line joining the eye and the flame, we shall see a number of reflected images of the flame on the different glass surfaces of which the lens is composed. Watching these carefully, we swing the lens round until they all close up and overlap to form one image as we look straight through. If they come together gradually and regularly, and if all exactly overlap at the finish, so that only one image of the flame is to be seen, the centring is satisfactory.

Before putting the lens in the camera there are one or two other things which we may note. Its surfaces should be very highly polished; there should, of course, be no sign of greyness or of imperfect polishing. If the lens projects beyond the metal of the mount, it should be examined for scratches and injury on the projecting surface, a very common defect in second-hand lenses which have been owned by those who did not know how to use them. A lens, of course, should not be cracked, but it may come as a surprise to many to know that the principal injury produced by a crack applies to its selling value, and not to its performance. If the same blow that caused the crack did not affect the centring, it is doubtful, unless the crack is very bad, whether its effects could be detected at all in the work done by the lens.

The mount of a lens generally prevents it from being used to quite the extent it might be otherwise. This is not necessarily a defect, and in at least one famous type, the mount was expressly arranged to prevent the lens from being used for purposes for which it was not intended, and so perchance

appearing inferior. Latterly, however, the tendency has been all the other way, and some lenses are not provided with sufficient mount to give them a reasonable protection from accidental injury. To ascertain if the mount of the lens gets in the way is very simple. Focussing some distant open view, the ground glass is removed, and the eye is brought to the position of one corner of it. In many cameras the corners of the ground glass are cut away, and in these all we have to do is to apply one eye to one of these openings and look into the lens, which must be at its largest opening. If the opening of the stop does not seem its proper shape from this view point the mount is cutting off, and smaller and smaller stops must be inserted until one is found which is seen in its true shape. This is then the largest stop which can be employed without the mount affecting the evenness of the illumination of the lens; and, other things being equal, the larger this stop is, the better is the lens in this respect.

So far the lens has been examined in the hand; it must next be placed in the camera and tried on the ground glass. In doing this, it is most important that the flange of the lens should be quite flat upon the camera front, as anything which tended to tip the lens to one side or the other, however slightly, would deprive the test of all its value. This fixing is not so important when the lens is to be used temporarily on a camera, under conditions which are not likely to be trying. It is possible, if the hole in the camera front is too large for the temporary lens, that this can be fixed by cutting a hole in a piece of black card so that it just fits on the screw of the lens mount, pushing this through the card, and holding the lens to the card by screwing on the flange. The card is then fastened over the hole in the camera front. Such a make-shift, however, is quite unsuited for testing a lens, and would make the lens seem much worse than it really is. For the same reason, when trying a lens in the camera, it is of the very utmost importance that both the back and front of the camera shall be precisely at right angles to the base-board. Having seen to this, we shall be in a position to examine both the "covering power" and the "defining power" of the lens.

For testing purposes it is quite useless to employ such a subject as a person or a landscape, because its different parts

THE VILLAGE PREACHER

BY DAN DUNLOP

are at different distances from the camera, and it is not possible to distinguish the want of definition due to this difference of distance from that caused by any shortcomings of the lens itself. For this reason a flat object must be employed, and nothing is better than a newspaper opened out as much as possible and pinned flat upon a wall. The larger the type on it, in reason, the better. Opposite such a subject, taking great care that the lens is opposite the middle of it, and that the camera is quite square with the wall, we take our stand. Covering the head with the focussing cloth, we proceed to focus the picture as sharply as possible, using the full aperture of the lens, and removing the camera from the subject, if possible, until we can see about half the newspaper on the ground glass. The first thing to note is the "covering power" of the lens—that is to say, whether it will give an image over the whole of the ground glass. To ascertain this we look to the corners. They may require focussing again, but the image should be visible there when the lens is opposite the centre of the focussing screen. If it is not visible, then the lens will not "cover" that size of plate at all, and is useless for it. But it ought to do more than this, because we are sure to want to use the rising front at some time or other. We raise the front now, little by little, looking at the bottom corners and refocussing when necessary, to ascertain how much the front can be raised before the corners are cut off. This test it is well to repeat on some landscape subject at the first opportunity, as, in consequence of the comparative nearness of the newspaper to the lens, the photographer may be led to suppose that he has a greater power of raising the lens than he will find to be the case when he comes to use it out-of-doors.

Unless the lens is one of the modern "flat-field" instruments, it will be found at once, on trying it in this way, that when the centre of the picture is sharp the edges are blurred, and *vice versâ*. If it is of either the "single" or the "rectilinear" type, this curvature must be expected. It may not give any very great trouble, because such lenses are not likely to be used much for copying from the flat, as in the test subject; but if the lens is supposed to give a flat field, and there is found to be any need for refocussing to get the corners sharp after focussing on the centre, it is defective. If all the four corners come

sharp together, it may be taken that the wall and the ground glass are parallel, and that the test is a good one; if they do not, the apparatus must be re-arranged before the test can be considered conclusive. Curvature of the field is a serious matter when copying with large apertures, but for many other purposes is not at all important. It has the effect of requiring objects at the edge of the plate to be nearer to the camera than objects which fall on the centre of the picture; so that in many cases it is possible to arrange the subject accordingly; we can get the outside members of a group to come a little closer, for example. In landscape work this is not possible, though even then it is not often very troublesome. It can be remedied by the use of a small stop.

The same test subject will allow us to examine the lens for "astigmatism." We select some of the black lines on the newspaper which run parallel to each other, such as the "rules" that are placed between the columns, and focus these with full aperture as sharply as we possibly can. On examining lines that run in a direction at right angles to these, if the lens suffers from astigmatism, we shall find that they are not sharp. If we focus the second lot of lines, the first will become fuzzy. All the older forms of lens, portrait, rectilinear, etc., possess astigmatism, but the modern types should be capable of going through this test without revealing any trace of it to the unaided eye. Astigmatism is a serious handicap when a lens has to be used for copying work, and is a distinct drawback in architectural photography. For most ordinary purposes, however, except that the definition of a lens suffering from astigmatism is never quite so good as when it is free from it, it is possible to reduce it by the use of a smaller stop. The lenses where the photographer is most likely to encounter astigmatism are the rapid rectilinears, of which so many are now in use. These vary enormously in this respect; some do not show more than a trace of it at the corners of the field, with others it is easily seen almost as soon as we get away from the centre of the picture.

There is another defect which may be looked for while this test is in progress. Let the camera be so arranged that one of the aforesaid "column rules" is represented on the ground glass at the extreme edge of the plate. If we focus it sharply

and then apply a straight-edge to the ground glass, the line which was straight in the subject may appear curved in the image. With a portrait lens this is certain to be the case, and may be passed over, as this form of distortion is not important in the work to which such lenses are put. It is also inevitable in all single lenses, although some manifest it in a much higher degree than others. All rectilinear lenses, however, should be absolutely free from it—their very name implies this—and if not they should be returned forthwith to the maker. Modern high-class lenses, also, should show no signs of it, except when one-half of the complete lens is used by itself, and even then it should be difficult to detect the distortion. There is no cure for this defect at all; it is not remedied by stopping down, and it unfits a lens for most architectural photography and for copying. For landscape, portrait, and hand-camera work generally, its presence, to the slight extent generally met with, makes no difference.

Distortion has no effect at all on the centre of the picture and is due entirely to the position of the stop. In single

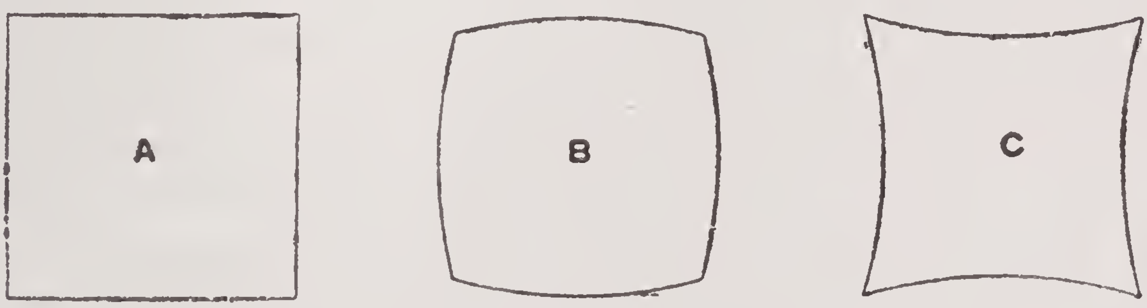


Fig. 7.

lenses the stop is generally placed in front of the lens, that is between the lens and the subject. If with this arrangement we photograph a square, as in A, Fig. 7, the distortion gives us a figure such as B, this is known as "barrel-shaped distortion." If the stop were put behind the lens, we should get the form shown in C, "cushion-shaped distortion." The further the stop is in each case from the lens, the better is the definition and the worse the distortion. When, as in a rectilinear, the stop is midway between two lenses, the one kind of distortion neutralizes the other, and an undistorted image should be the result. While no degree of stopping down will remedy distortion, it can be reduced by lessening the distance between the lens and the stop; this impairs the

definition, which in its turn is remedied by the use of a smaller stop. It is possible when a negative shows distortion, to make an enlargement from it with a single lens, with the stop in the opposite position, so that by again distorting the picture, but the opposite way, an undistorted result is finally attained.

Theroetically the curves of a lens should not be parts of spheres, but should have a parabolical form. Such a form, however, presents such immense difficulties in manufacture as to put it quite outside the sphere of practical optics, the consequence is that photographic lenses suffer to some extent from what is known as "spherical aberration"; although in the best forms, this is reduced to such a degree that it is not capable of detection in the ordinary way at all. To detect spherical aberration, a circle of black paper should be cut, the size of the front surface of the lens. Out of the centre of this should be cut another circle having a diameter of about two-thirds the first. This smaller circle is fastened in the centre of the front of the lens, with a drop of moisture, and the image is sharply focussed; thus using the edges of the lens only, to form the picture. Removing the circle, without shifting the lens, it is wiped clean, and the black ring substituted for the disc, thus using the centre of the lens only. If the image is still sharp, there is very little spherical aberration, but if it has to be focussed again, the defect is present. The extent to which focussing has to be performed is an indication of the spherical aberration present. It is to be met with in all the cheaper forms of single lenses, in rectilinears and in portrait lenses; but should not be noticeable in an anastigmat. It is reduced by stopping down.

However perfect a lens may be in all other respects, there is always a possibility that its good points may be neutralized entirely by what is known as a "flare spot." Given a sufficiently trying subject almost every lens can be made to yield a "flare"; but if it is to be of any use at all, the flare spot must, under all ordinary conditions, be conspicuous by its absence. To examine for it, the camera should be taken into a room where it can be set up at some distance from a bright object, such as a window. Arranging things so that the image of the window falls on one corner of the plate, we must look carefully all over the ground glass for a disc of light or

"ghost" of the image. If we do not see one at first, it may be visible when the camera is moved a little. It is to be sought on the side of the centre of the field opposite to the image of the bright object. If it is present under these conditions the lens is of little or no use. Single lenses, as a rule, are free from flare spot, but the more separate surfaces of glass there are in a lens, and the steeper the curves of those surfaces, the more chance is there of trouble from this defect.

A "flare spot" is the term generally applied when the flare is well defined; when it is not so and is only present as a haze over the picture it is spoken of simply as flare. There must always be a certain amount of flare, but there should not be a flare spot. Before condemning a lens for flare, it is well to make quite sure the defect observed is not merely an image of some bright metal on the lens mount itself. The space between the combinations of a doublet lens, or the leaves of the stop or of the shutter, if the black is worn off, may give rise to what is at first supposed to be flare, yet is nothing of the kind. The lens should also be examined to make sure each separate glass is screwed into its proper place; as in a carefully adjusted lens, a slight unscrewing of the one or other of its components may give rise to a flare spot, which disappears on the lens being properly screwed up.

One more possible defect concludes the list. In lenses composed on one kind of glass, the rays of light of different colours come to a focus at different distances from the lens. Thus, if with such a lens we were to focus sharply the red light of a railway signal, we should find when it changed to green that it was no longer sharp, while if it changed to blue or violet as some signals do, the fuzziness would be still more pronounced. All colours are bent aside by a prism to different degrees; in fact, we distinguish between them by saying that different coloured rays are of different "refrangibility," or bendingableness, to coin a word on the German system. Lenses to be used with the eye only, such as are employed in microscopes and telescopes, are "corrected" by the use of more kinds of glass than one, so that as many of the rays as possible come to a focus where the yellow rays do, yellow being the light to which the eye is most sensitive. In photographic lenses, much of the light to which the plate is sensitive is blue violet or even

invisible, and this has to be taken into account when correcting lenses for use in photography. Lenses "corrected for colour" are said to be "achromatic."

If we take an uncorrected lens and with it focus an image as sharply as possible, we shall find in consequence of the lack of correction, that the photograph is not sharp. As a matter of fact, the focus for those rays which most powerfully affect the plate is nearer to the lens than the sharpest position to the eye, by about one-fiftieth of the focal length. If, then, it is a 5-inch lens, and after focussing it is racked in one-tenth of an inch, the image on the negative will be sharper than if this is not done. (But even so, no uncorrected lens will give as sharp a picture as one that has been properly achromatized.) There used to be "periscopic" lenses on the market (used in hand-cameras in which focussing is either not done at all, or is done by scale), which lenses were not achromatized, but the difference is allowed for in fixing them in the camera. These were only supplied in the very cheapest forms of apparatus, the definition at best is very poor, and are practically obsolete.

It may be taken that all photographic lenses, properly so called, should be achromatic. To test this properly, if we can only be quite certain that the plate and the ground glass come exactly into the same place, and without this the test is valueless, nothing more should be necessary than to focus sharply some one of a series of objects at different distances from the camera, and expose a plate. If the sharpest object in the negative is that upon which the camera was focussed, the lens is properly corrected for colour; but if some object at a different distance is the sharper, then the lens is not properly corrected. This test is vitiated by any difference between the positions of the ground glass and plate respectively.

To avoid this, and other possible inaccuracies, the following method of performing the test is a good one. Seven white cards, each about 2 by 8 inches are taken, and a hole is punched out at the end of each so that they can all be stiffly carried on a cedar pencil. At the other extremity of each card a number should be written in bold characters with good black ink. The cards are arranged at intervals of 1 inch on the pencil, and the seven are placed round it, so that on looking at the whole arrangement from one end, all the numbers are seen

in order, in a circle, each number being 1 inch behind the next lower one. The pencil is fixed up horizontally in this manner, and the camera a few feet away, is set up, so that the numbers appear in the middle of the picture. The ground glass is placed in the dark slide itself, which is opened for the purpose, and while held in position the card marked No. 4 is focussed as sharply as possible. A plate is then substituted for the ground glass and the exposure is made. Number 4 ought to be the sharpest in the negative also.

As in nearly every case, photographic lenses are only corrected for those rays which are most active on the plate, as soon as we come to use orthochromatic plates, with deep yellow screens which cut off nearly all these rays, such lenses no longer give a sharp image. This is particularly noticeable in three-colour work, where the colour screens cut off the light so decidedly that very few lenses, none in fact, unless specially well corrected, will give three pictures equally sharp without being refocussed, except when the focus is very short. In all ordinary cases, therefore, when a colour screen and orthochromatic plate are being used, the focussing should be done with the screen in position.

A good many of these tests are such that the photographer may not feel that he has sufficient skill to make them, or knowledge to appreciate them when they are made; in such circumstances, he will do best if he intends to get a first-class modern lens, to go direct to one of the good makers and take what they are prepared to supply. He cannot then go far wrong. If he wants a specimen of work done with it, on no account should he take a landscape, portrait, or even an architectural subject, but should have a negative of a flat test subject, such as has been here suggested, taken with the full aperture of the lens, and taken on a much reduced scale. This scale should be indicated. It is only under such conditions that the test negative will give any true indication of the qualities of the lens. Many of the specimens shown in shops are intended to catch the eye of those who are not in a position to know what a good lens should do; and are shown in the belief that those who are influenced by them will not know that good work may be done with a very poor instrument, if only the user knows how to make the most of it, and if the conditions are favourable.

CHAPTER IV

PINHOLE PHOTOGRAPHY

Pinhole work—The character of the definition—Making pinholes—Measuring them —The sizes of needles—The camera extension—Arranging the subject—Over-exposure possible—Working out the exposure—Some advantages of pinhole work.

THE simplest contrivance for forming an image is a pinhole, and for landscape work, where the long exposure is not going to be troublesome, the pinhole is still useful. It has this advantage, that the image can be got on any scale with it, as it is always equally sharp (or almost so) however the focussing screen is pushed in or out. If, therefore, some particular object is to occupy the greater part of the plate, we may extend the camera and get its image larger and larger until it is the size we want; and we may go nearer to or farther from the object, until we get the drawing we want. With a pinhole, also, while there is at no time any very fine definition, there is not that gradation from sharp to blur, that is given by a properly corrected lens used at a large aperture.

It was Dr. Emerson who first laid great stress on "differential focussing"—the sharpness of the image suited to the requirements of the picture, and blurring allowed to stifle obtrusive details. There is nothing to be said against the practice by pictorial photographers, but it is not as easy as it sounds. If the lens has a flat field, everything the same distance as the principal object will be sharp with it, whether it is wanted so or is to be subordinated by diffusion; while if the lens has not a flat field, the focussing may be more erratic, but it is no more under the control of the photographer. While Dr. Emerson used it at times with complete success, other instances may be selected from his own work to show the limitations it imposed upon him. The pinhole knows none of these distinctions of

RODIN—LE PENSEUR

BY STEICHEN

definition. If none of its image has the critical sharpness demanded by the optician, none need have any pronounced blur; and plenty of pinhole photographs exist which, put in an album with others taken with lenses, would not attract attention from any imperfection of definition. The fact is, there is a fine quality about the pinhole image which, were it not for the lengthy exposures, would render it very popular for many purposes. The actual softness depends on the diameter of the hole; the smaller the pinhole, the sharper the picture, within limits.

Pieces of metal pierced with a hole of a definite size are on the market, and Watkins makes one which can be used, very conveniently, in connection with his exposure meter; but there is no actual necessity to purchase a pinhole, or even to make one in metal before trying a pinhole picture. Very good pinhole work has been done by removing the glasses from a lens mount, and placing a piece of blackened card across the opening of the stop. In the centre of this card is a hole about a quarter of an inch in diameter, or less, closed by gumming over it a piece of the thinnest black opaque paper procurable. When dry and tight, a hole is perforated in the black paper with a red-hot needle, using only the point, and the hole is then enlarged with the cold needle, until this just passes through it. With a little care all burr on the edges can be avoided. Mr. Combe, who has done much good pinhole work, recommends that the pinhole should be punched in a piece of the thinnest sheet brass procurable, using the point of a needle, and placing the brass on a piece of glass with a sheet of paper between the two. The needle is just allowed to perforate the brass, and then the burr is rubbed off with a piece of fine emery-paper. It is pushed a little further, and the burr again rubbed off; then a little further, and so on until the whole needle will just pass through the brass. The brass is then blackened.

The idea of making the hole so that the selected needle will just pass through it, is to allow the hole itself to be measured; as unless we know its diameter it is not possible to calculate the exposure it will require. The easiest way to measure it is to take care to have plenty of needles of the size, or of the maker's number, used in piercing the hole. Two visiting-cards are then gummed down on a stouter card side by side, parallel

and with exactly an inch between their nearest edges, and the needles are arranged between the two cards until the space is fully occupied, if forty needles are required to do this, the diameter of each must be one-fortieth of an inch, and this may be taken, with sufficient accuracy, as the diameter of the hole through which one of them will just pass. There is no absolute need for the cards to be an inch apart, half an inch or even a quarter may be sufficient to give the size of the needles. Another method is to pierce two holes in a piece of thin black paper with the needle that is to be measured, the holes being as accurately as possible an eighth of an inch apart. The paper is then put into an enlarging lantern and as big an image as possible is sharply focussed on a piece of white paper. The size of the image of the holes and their distance apart is marked on the paper with a sharp pencil, and measured at leisure. The actual distance apart in eighths of an inch gives the degree of magnification, and the diameter of the image of one of the holes divided by the degree of magnification gives the actual diameter of the hole. Rev. J. B. Thomson, who has done much pinhole work, points out that the three most useful sizes of holes are those made by No. 10, No. 11, and No. 12 needles, and that these are, approximately, $\frac{1}{55}$, $\frac{1}{65}$, and $\frac{1}{75}$ inch in diameter respectively. Of these, No. 10 is the most generally useful, but at times even No. 8, $\frac{1}{45}$ inch, may be a convenience. By using these needles, the necessity for measuring the hole itself is avoided.

Though there is no fixed position of the focussing screen in pinhole work corresponding to the focus of the lens, there are limits within which alone the pinhole can be used, though these are very wide limits, the angle included on the plate being at least as variable as with ordinary lenses. For reasons which need not detain us, there is a position for the focussing screen where the definition is at its best, but the improvement over other positions is not sufficiently great for that to be determined by trial, while the position given by theory is still a matter of discussion. Mr. Combe says that the best camera extension is that obtained by squaring the width of a hundred needles of the size employed to pierce the hole, and dividing the result by eight. If the plate is placed at this distance from the pinhole the maximum of sharpness is obtained. As the pinhole allows

very little light to enter the camera, it is hardly possible, except when circumstances are very unusual, to arrange the subject on the ground glass by means of it. Some pinhole workers carry a comparatively large hole which they use for this purpose, substituting the smaller hole when exposing. An alternative plan is to remove the focussing screen entirely, to turn the camera round until it points away from the subject, and then putting the eye to the pinhole, to arrange the picture in the opening formed by the frame that held the ground glass, racking this in or out until the proportions borne by the different parts of the subject are those required. By taking a sight along one angle of the camera, it should be possible, then, to turn it round until it is pointing in exactly the opposite direction, when the picture as seen through the pinhole will be that which falls on the plate. This is not absolutely the case, unless the pinhole is exactly above the tripod screw on which the rotation was performed, but, provided the tripod top is level, it is quite true enough in all ordinary cases.

It has been said that it is impossible to over-expose with a pinhole; probably all that is meant is, that those who are accustomed to lens exposures and do not trouble to find out what the relative pinhole exposures should be, are not likely to over-expose. Otherwise over-exposure is just as easy as it is with a lens. Theoretically, the pinhole, aperture and extension considered, should be faster than a lens, as all glass absorbs a great deal of the invisible ultra-violet light to which the plate is sensitive; but the reverse seems to be the case, and exposures may be increased by about half as much again as the F/- number would seem to require. To determine the exposure with a pinhole this F/- number must be calculated. The length of the exposure generally allows this to be done deliberately enough. The diameter of the hole being known, an extension of 1 inch has that as its F/- number. For instance, with a No. 10 needle which gives a hole $\frac{1}{55}$ inch in diameter, when the plate is an inch from the hole, we are working at F/55. The exposure for F/55 is obtained exactly as if a lens at that opening were being used. Of course a much longer extension is employed, and the exposure is increased as the square of that extension. Thus if the distance from the hole to the plate is 8 inches, the exposure is eight times eight or sixty-four times that with F/55,

or may be regarded with sufficient accuracy in such a case as as many minutes as F/55 needed seconds. This time may then be increased to half as much again as just pointed out. There is no real difficulty about working out these exposures, as they can be done with pencil and paper after the exposure is started; but by using the gauged pinhole supplied by Watkins, the application of the Watkins meter to pinhole work becomes still easier. A lens cap or shutter is not required for work of this character, the focussing cloth may be hung over the hole to obscure it while drawing the shutter of the dark slide, but even this is not often required.

In other respects, pinhole photography does not differ from that done with lenses. The drawing is the same as with any rectilinear lens. The swing back and rising and cross fronts serve the same purpose with both. The prolonged exposure is not always a drawback. In a crowded street, where buildings are wanted, and the traffic is a nuisance, by using a very small pinhole the exposure is so prolonged that all the moving parts are lost entirely, and the buildings appear without any sign of traffic before them. In landscape work, wind may be very troublesome, especially if it is a high wind, but a great deal of the trouble which one may experience with a lens, from the trembling of leaves when a faint breath passes over them, is missed together, the pinhole giving a sort of "average" position for leaves and branches, from which any momentary departure has not been recorded. Pinholes have been used for portraiture. The definition given by a fairly large pinhole in such a case is very agreeable, and the prolonged exposure is not without its good points also, in doing away to a large extent with fleeting expressions and getting an "average" result. But exposures usually run into several minutes, even under the most favourable conditions.

CHAPTER V

THE DRAWING OF A PHOTOGRAPH

No essential difference in perspective between a photograph and a painting—View point the ruling condition—Impossible view points—Pugin—Wide angles suggest distortion—Suitable lenses to avoid the appearance of strained perspective—The centre of the picture plane—Different appearances from the same standpoint —Plane perspective—Panoramic or cylindrical perspective.

THE idea that in some way or another the perspective of a photograph differs from the perspective of a painting goes deep into the painter's mind, and is possessed somewhat hazily, perhaps, but still possessed by the public and by many photographers. Yet any difference that there may be is due entirely to casual imperfections of the painting or of the photograph; the photographic image, with only reasonable care, is true every time, and the painting in all matters of perspective as closely resembles a photograph as the painter can get it. Later on we shall see exactly of what the supposed difference in drawing between the two representations consists; for the present it is well to recall exactly what it is that both photographer and painter try to obtain.

If a scene in nature is looked at through a window with one eye only, keeping the eye steadily in one place, everything visible through the glass can be referred to some place on the glass, so that if we had a steady hand and a brush set in a long handle we might sketch on the glass the outline of the scene in question; and so long as the eye, the glass, and the scene, were unmoved, the outlines of every detail would fall in exactly the same place on the glass. If the glass were vertical, the outline sketch so made would be identical in perspective with the drawing which a painter would try to make if he desired to represent the scene as viewed from the point occupied by the eye, and any difference between the two would be due to the painter's

want of ability. In the same way, a photograph taken with the lens in the position occupied by the eye would give identical drawing with that on the glass. The only difference would be if the plate in the camera were not vertical, or if a single lens were used under severe conditions, when some of the lines which were straight in the original might appear slightly curved in the photograph. Such a drawing as we have imagined would be said to be in true monocular perspective.

What then is the cause of the supposed difference between the "perspective" of the painter and of the photographer? It is twofold. In the first place, the photographic lens will include a much wider angle than the human eye, and if the photographer allows this wide angle to be included in his picture, he at once gets an apparent falsity. It is not a defect of the lens, but merely a superabundance, and can be corrected by trimming the print down. In the second place, the photographer must go to his standpoint and set up his camera there, or he cannot get the view as seen from that standpoint. The painter is under no such restrictions. He can sit and work in one place and make his drawing as if it were seen from another, which other may be inaccessible or even impossible. Thus, in Pugin's "Normandy," the interiors are drawn as if one of the sides of each building was removed, and the interior seen from a point some distance outside.* Could the wall have been pulled down and the camera placed there, the photograph would have given precisely the same drawing as that at which the draughtsman aimed, but in the circumstances it could not, and the photographer has at least the consolation of knowing that no eye could ever see the building as it was drawn, and that the drawing, however well it may record the details and the proportions of the structure, does not and cannot give any true impression of that general effect at which the architect himself aimed. The result is that in every case the visitor whose ideas of the structure have been gathered from the drawings, has a feeling of disappointment when he first sees the reality. It looks narrowed and dwarfed.

It is generally only in portraiture and architecture that there is any suggestion of distortion about a photograph that includes too wide an angle; but in landscape, if it is not

* Sherar's "Perspective Tables," p. 40. Sinclair: Edinburgh, 1905.

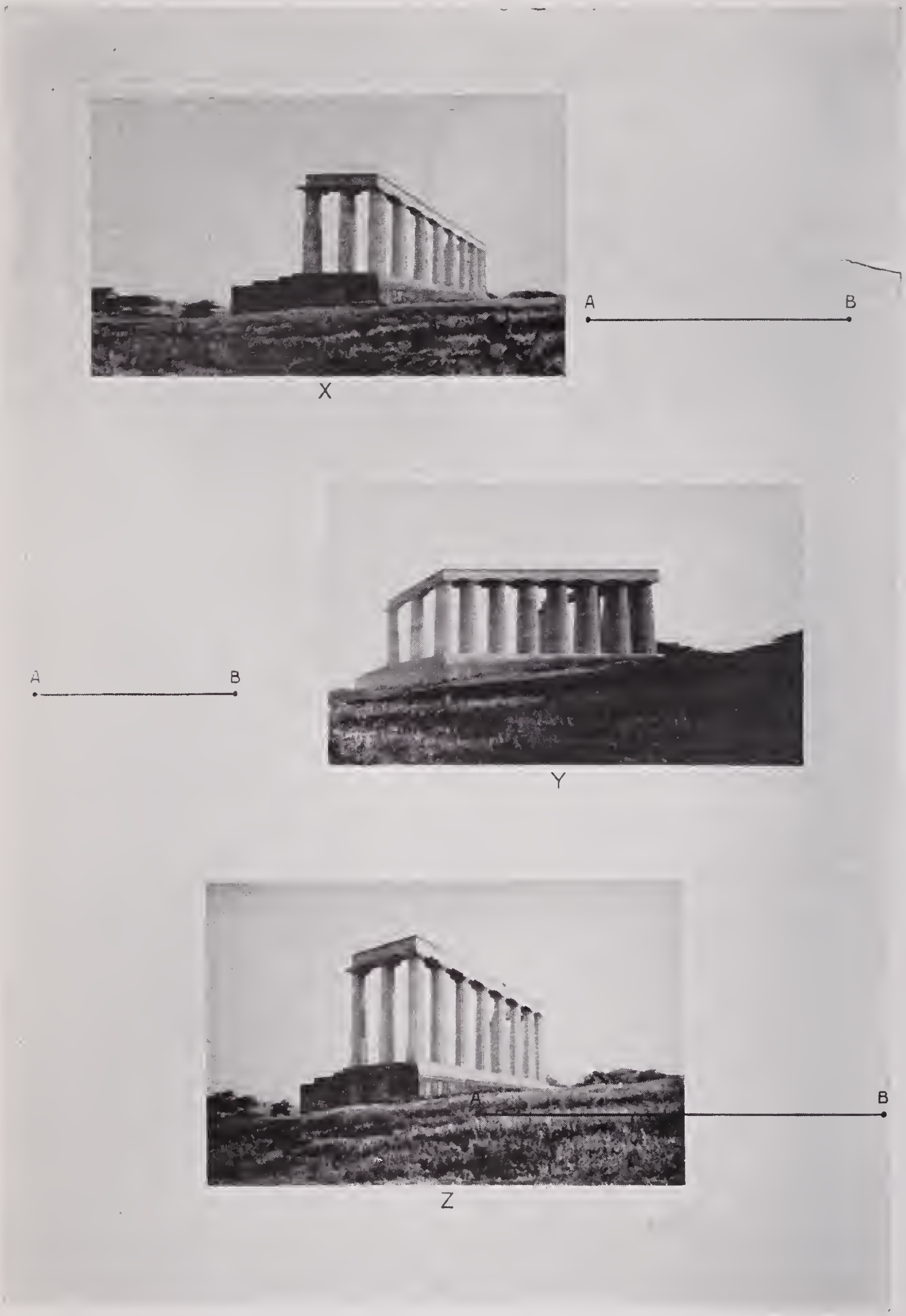
actually suggested, the error is there all the same, and is best avoided. Even photographic lenses of ordinary angles include too much to give the best effect, which, it will be found, can only be ensured by the width of the picture being kept down to a *maximum* of one and a half times the focus of the lens; less is better. This can be done, of course, simply by trimming the print ; but, as with a wide angle lens, this would mean that a great deal of the area of both plates and prints might be wasted ; it is better to obtain the same result by the use of a longer focus lens. Thus, if we wish every photograph to be free from suspicion of "strained perspective," a $6\frac{1}{2}$-inch lens would be the shortest focus to be used on a quarter plate, a 10-inch on a half plate, a 13-inch on a whole plate, and so on. Such lenses, though theoretically those which ought to be used, are fully long for many purposes, and photographers therefore generally use 5, 7, and 10-inch lenses or thereabouts on the sizes named. In most cases the difference is not very appreciable, but where the subject is of such a character as to show up any excessive angle, these generally used lenses will give results which, unless trimmed down, will look distinctly false.

The so-called distortion of photographs is, therefore, due to the selection of a standpoint which is unsuitable, and to the inclusion of too wide an angle in the picture. If such a lens as we have supposed were selected, and the photographer were limited in size to the plate for which it was designed, say a 10-inch lens on a half plate, none of the alleged distortion could exist, as he would be compelled to select the more distant point of view if he wanted to get as much of the subject on the plate as he would with a shorter focus lens. It would be a very simple way of preventing the apparent falsity, but would hamper him considerably in some classes of work, as he would often find the more distant view point inaccessible, as in the case of the Normandy interiors already cited.

The drawing of the lens, then, is the same as would be obtained by placing the eye at the position of the lens and a flat sheet of glass vertically between the eye and the subject, and tracing the outlines of the subject where they appeared to fall on the glass. The focus of the lens only decides the scale of the picture, the position of the eye decides the perspective. The position of the glass is also important. There has long

been a convention in drawing that all vertical lines in the subject shall be rendered in the perspective drawing as vertical too, and, therefore, parallel to each other. This is rendered necessary by our habit of regarding all pictures as hanging vertically, with the axis of the eye directed towards their centre. In order that this convention may be complied with, the sheet of glass on which our perspective picture is supposed to be traced must be vertical also. For the same reason the photographer's plate must be vertical, and if the camera is tipped up, the back must be swung to bring the plate so, or all upright lines in the subject in the picture will appear to fall together at the top. That this is purely a convention can be proved by those who care to take the trouble, by making such a distorted photograph, enlarging it, and then fixing it in a box in such a way that it can only be seen by applying the eye to a hole in a box in such a position that the bottom of the picture is much nearer to the eye than the top. A position can be found, without very much trouble, in which the most distorted picture will look perfectly natural.

There is another aspect of this perspective question which does not have the attention it deserves from photographers; and that is the position of what Mr. Sherar, in the admirable little book already mentioned, calls "the centre of the picture plane." He is writing for draughtsmen; but we may apply his argument to photography to our profit. A perpendicular to the imaginary sheet of glass may be dropped from the point of sight. This is "the perspective axis" or the "axis of the picture plane" and the point at which it cuts the surface of our imaginary sheet of glass is "the centre of the picture plane." It is well the sheet of glass is imaginary, as it may have to undergo considerable extension to be cut by the perspective axis at all. Now the appearance of the subject may vary enormously according to the position of the centre of the picture plane, which may be in the centre of the picture itself, or a long way outside it. This can hardly be better illustrated than in the three photographs which, by the courtesy of Mr. Sherar, we are enabled to reproduce from his book, "Perspective Tables." These were all taken from absolutely the same standpoint, and differ only in scale and in the position of the centre of the picture plane.



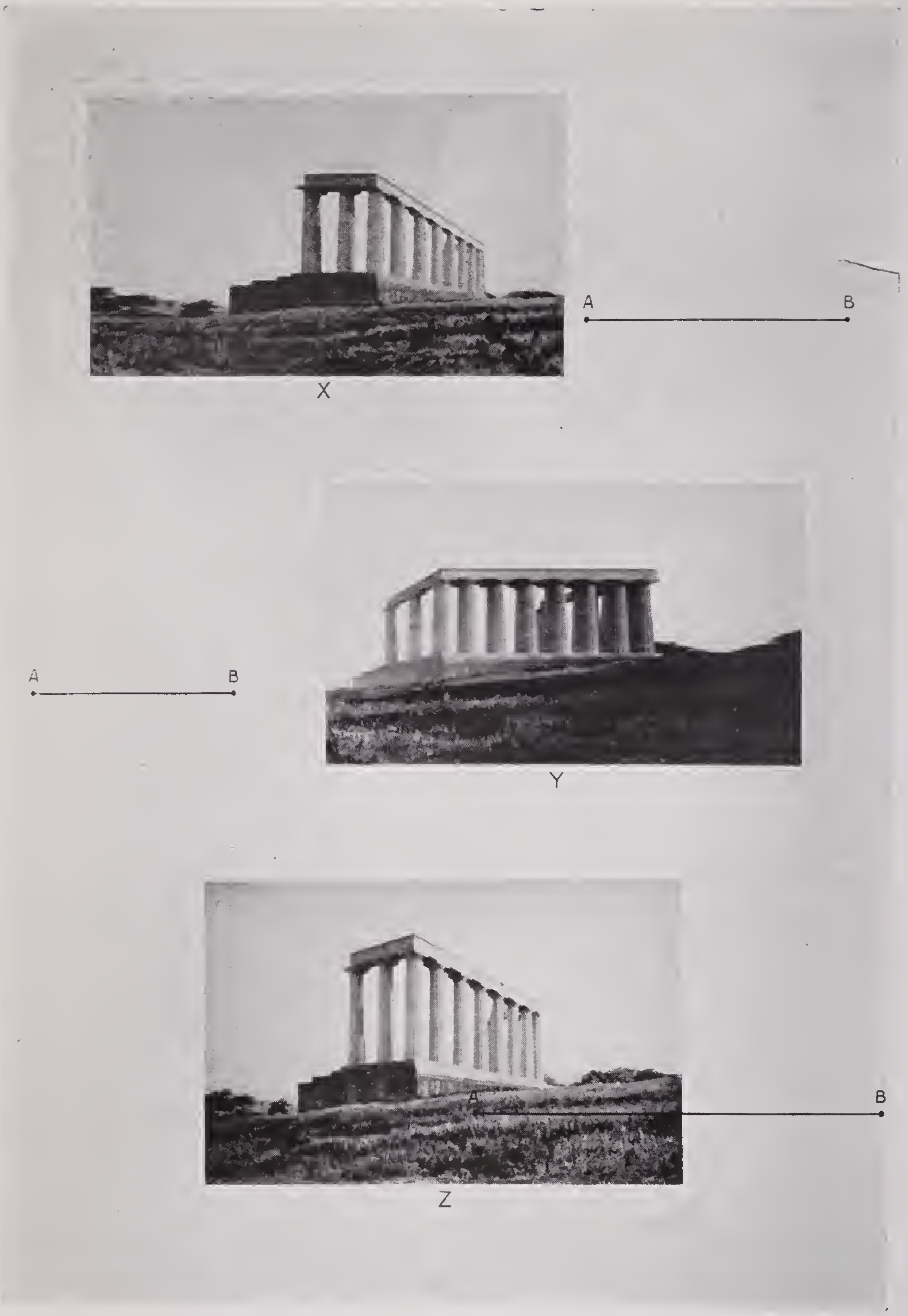
THREE PHOTOGRAPHS FROM THE SAME STANDPOINT

(See p. 65)

REPRODUCED BY PERMISSION OF THE AUTHOR FROM "PERSPECTIVE TABLES" BY ROBERT F. SHERAR

Few photographers would suspect that all three pictures were taken without moving the tripod. They are, of course, not put forward as examples to follow, but as exaggerations to illustrate the effect. In Z we have the view of the building which the photographer would secure who turned his camera to face the building and then trimmed his print liberally on all sides. In the other two we have the pictures he would get by turning the camera away from the building till it was only just included on the edge of a picture obtained with a wide angle lens, one showing the result with the camera turned one way, one the result with the other. We could either take the two latter pictures each on a large plate, with the lens opposite its centre, and then trim more than half of each print off on one side, or we could slide the lens on the cross front until that part of the field of view which contained the building was central. The results of the two methods would not be appreciably different in drawing.

The photographer has little difficulty in determining the centre of his picture plane, as this must always be where the axis of the lens cuts the plate, provided the back and the front of the camera are parallel. If the back is swung at all, the centre of the picture plane is no longer on the axis of the lens, but is where a perpendicular from the optical centre of the lens would cut the plate or its prolongation. There is little need to know the position of the centre of the picture plane; what is important is to see that no very great distance separates it from the centre of the picture itself, if the effect is to look true. The two pictures X and Y only convey a truthful impression to the eye if viewed with the eye in a line perpendicular to A and B respectively at the distance AB. To get the eye as near as this and yet to see clearly requires a weak magnifying glass. As the spectator of a picture has little or no guide as to the proper position from which to view it in order to get a truthful effect, and as his tendency is to see it at such a distance as makes its width subtend an angle of from thirty to sixty degrees while standing approximately opposite to some part of it, and not opposite the wall beyond one of its edges, it has become a recognized convention that a greater angle than sixty degrees should not be included, and that the centre of the picture plane shall be within the picture itself. There is no



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need for it to be in the centre of the picture, in fact, in very many cases it is better not to be so, but it ought not to be very far from the centre if the impression is to be a truthful one ; while another reason for a central position is that in any other, the lens is not being used at its best.

The difference in drawing which is obtained from different standpoints is often overlooked by the photographer, whose main concern seems to be "to get it all on" the plate ; and we often see one approach a subject with the sole idea of increasing its scale on the plate, although by doing so its perspective may suffer. Apart from the abruptness of the convergence of lines obtained in this way, the principal photographic effect is in the scale of the distance as compared with the foreground. The images of two men, one of whom is three or four yards further from the camera than the other, if photographed from a distance of say four yards will appear widely different in size. If they are taken with a much longer focus lens from a distance of twenty or thirty yards, they will be almost alike in size. Concentrating the attention on a near object, as is usually done when photographing, and getting it in each case of the same size on the plate, the nearer the camera is to it, the more the distance is dwarfed in size in proportion to the near object.

There is one other aspect of this question to be considered, and that came into prominence a few years ago by the introduction of panoramic cameras, in which the film was curved and the lens rotated. The drawing obtained with such instruments is quite different from that which all other cameras yield. We no longer have the perspective of the subject as it would be delineated on a flat sheet of glass interposed between it and the eye ; but as it would appear if the glass were a portion of a cylinder of a radius equal to the focus of the lens, and placed vertically (Fig. 8). There is no longer a picture plane, but a picture cylinder, and the centre of the picture plane has become a straight line. Consequently viewed as truthful representations of wide panoramas, such prints are unsatisfactory and false, unless seen under proper conditions. These are that the picture should be curved to the same extent as was the film originally, and the eye placed at the centre of curvature. When this is done, the drawing appears as truthful

as the most accurate one on a flat surface ; and even when it is not, the panoramic picture is less objectionable by far than would be one including the same angle, if that were possible, and taken on a flat plate, because the curving surface of the film prevents the apparent distortion of objects viewed by the lens very obliquely. The movement of the lens also removes all difficulty from the falling off in illumination so noticeable in wide angle lenses as we approach the margin of the field.

Photographic perspective, then, is in no sense whatever different from the perspective of the painter or the draughtsman. Any blame for apparent distortion must be borne not by the camera, but by its user, who has neglected to select the best point of sight for his camera, or has at least chosen to

Plane Perspective.

Panoramic or Cylindrical Perspective.

Fig. 8.

take it from an unsatisfactory view point rather than not at all, and has allowed too wide an angle to be included in his print. These faults are grave ones where pictorial work is concerned, or where it is important to convey a true impression even at the most superficial glance, but have no validity at any other time As a scientific record, a photograph of a building taken with some freak lens which may include an angle as wide as 130°, provided we know the standpoint, is no more untruthful or false or distorted than is a map of the world on Mercator's projection, which represents the poles as straight lines of length equal to that of the equator. Both are systematic representations of solid objects on a flat surface, and are only deceiving to those who cannot read their message aright.

CHAPTER VI

THE SELECTION OF A LENS

The uncorrected single lens—Corrected single lenses—Rectilinears and symmetricals—The wide-angle rectilinear—The advantages of the anastigmat—The Petzval portrait lens—Dallmeyer's modification; with the arrangement for diffusion of focus—Abbe and Schott and the Jena glasses—Anastigmats—Costly lenses—A nocturnal expedition—The Grün lens—The Hypergon—Telephotographic lenses—The Adon—The Dallmeyer-Bergheim lenses for pictorial work.

THE variety in design and construction of photographic lenses is very great, far greater, in fact, than in the character of the results obtained with them. This, from our point of view, which is that of the amateur photographer pure and simple, is something for which to be grateful, as the subject of lens calculation and design is hardly one to be taken up in a dilletante manner. It has been said to be the one occupation for which the education of a senior wrangler has fitted him, and it certainly demands a degree of mathematical knowledge which is not at all common. We can pass over all the intricacies of lens construction, therefore, and view them from a standpoint aptly described by a celebrated optician as that of the lens phrenologist, whose acquaintance with the inwardness of his instrument is limited to what can be got by feeling its bumps.

The simplest form, the uncorrected single lens, is still sometimes used by those who do not care for definition. When applied to another, as a "magnifier," it is usually so weak that its want of correction is slight enough in its influence on the combination to be ignored altogether, but a single lens to be used by itself will only give definition as good as that obtained with a pinhole by stopping it down very much. As it is not achromatized, the focus for the chemical rays will differ from that for the visual rays. After focussing on the screen with

such a lens, this has to be allowed for, by racking the back nearer to the lens after focussing by about one-fiftieth of that total distance. Some uncorrected single lenses are sold with a supplementary lens or magnifier which is inserted for focussing, and then is taken out, its absence making the allowance required. The aims and aspirations of those who use uncorrected lenses, however, are generally of such a kind that the subject of definition concerns them very little.

Many fixed-focus hand-cameras are fitted with corrected single lenses, and excellent work can be done with them. Their largest aperture as a rule is F/14, or F/16, and except that there is always some slight degree of distortion they are efficient, if not fast. For portrait work, particularly for large heads taken direct, a single lens may be used, and used at a large aperture, F/8 or even F/6. It is said to give greater roundness than the portrait lens, and is also by no means so heavy or so expensive. A portrait lens of 15 or 20 inches focus needs not only a specially built camera but almost a specially constructed stand to carry it, whereas a single lens of that length is not at all unwieldy. The longer focus is essential if the drawing of the portrait is to be satisfactory. Most single lenses are of the "meniscus" type externally; that is to say, one surface is concave and the other convex. It is customary to employ them with the convex side turned towards the plate, and the stop placed some little distance away on the other side of the lens. The single lens reaches its highest point of perfection in those anastigmatic forms which are composed of one completely corrected combination of three or four glasses cemented together, made to be used either by itself or with another of a similar kind to form a rectilinear combination. In such instruments perfect definition is the object, which of course, in the single lens for portraiture just referred to, is not the case.

Next to the single lens comes the "rectilinear," formed apparently of two single lenses placed with their concave surfaces towards each other and the stop between them. In certain very cheap forms, each of these two lenses is composed of a single glass. The lens is, therefore, uncorrected for colour and must be used in the way referred to earlier in this chapter. Such lenses were known as "periscopic" or as

"periscopes," and were not very satisfactory in any way, except that the distortion obtained with a single lens was got rid of almost entirely with them.

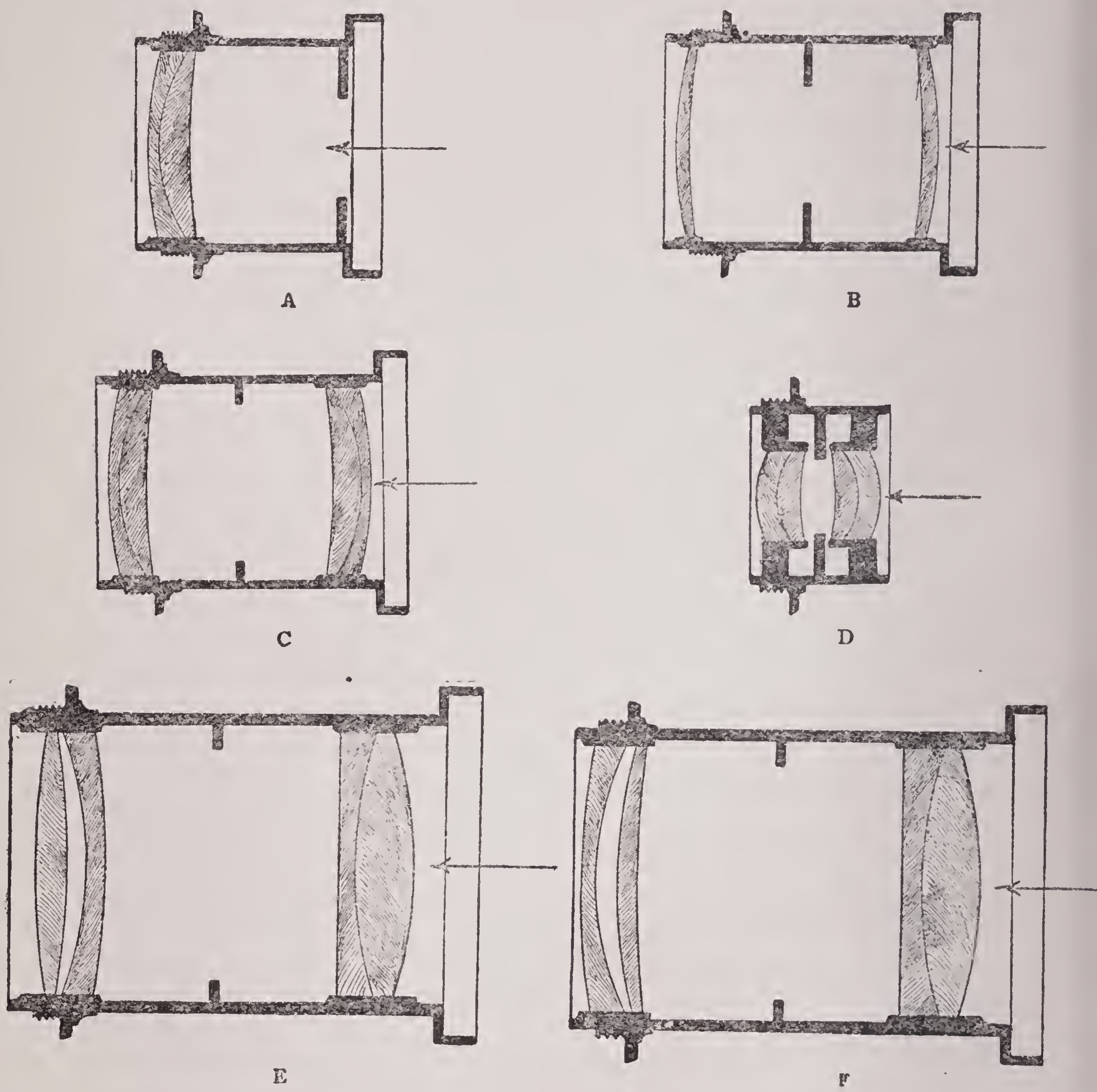

FIG. 9.—PRE-ANASTIGMAT LENSES—SOME WELL-KNOWN TYPES.

A. Corrected single lens (meniscus).
B. Uncorrected doublet (periscope).
C. Rapid rectilinear or symmetrical.
D. Wide-angle rectilinear or portable symmetrical.
E. Petzval portrait lens.
F. Dallmeyer's modified Petzval lens.

Practically all rectilinear lenses now sold are achromatic, that is to say, each of the two "combinations" consists of two glasses

cemented together, as shown at C and D in Fig. 9. One form of the rectilinear had its glasses close together, and a comparatively small stop between them, and was known as the wide-angle rectilinear. The rapid rectilinear usually has F/8 as its largest stop, but many have been made which could be used at F/6; these were known as "Euryscopes." The wide-angle rectilinear generally had F/16 as its maximum opening. There is not necessarily any real advantage in getting a rapid rectilinear that is fitted with a stop as large as F/6, as it cannot be used at this opening with any satisfaction, unless its angle of view is comparatively small. It must not be supposed in buying a lens that it is of necessity any better because its maker has fitted it with a larger stop than another. In fact, it may even be worse, as an indication of a lower standard either of definition or of business morality. No finer "R.R." lenses were ever made than the Dallmeyer rapid rectilinears, and the maker adopted for these a standard opening of F/8, although in exceptional circumstances such lenses were made with larger openings both by Dallmeyer and by Voigtlander.

The rapid and wide angle rectilinears for many years had an immense vogue. They represented the high-water mark of the optician, and were made by many under the most diverse names, though the most important syllables of "rectilinear" or "symmetrical" were usually worked into the greco-latin hybrids by which they were designated. They have now subsided into a type; they are no longer pre-eminent; their price has fallen; and if their reputation has not fallen too, it has at least dropped back relatively to that of rival forms. The Ross "Rapid Symmetricals" and "Portable Symmetricals" were practically rapid and wide angle rectilinears, and for long shared pre-eminence with the Dallmeyer R.R.'s, until the anastigmats by the same and other makers were introduced. A good rapid rectilinear lens is a very good all-round tool to-day, and may well satisfy those who cannot afford more expensive patterns. It may give results that are quite indistinguishable from those obtained with an anastigmat, provided it is used on work for which it is fitted—landscapes, architecture, and general photography. It is when it is employed at a large aperture, on subjects with very fine detail, and especially on flat objects as in copying, that the anastigmat begins to reveal its superiority; but except

where exposures must be very short, as in hand-camera work, there is no reason why any one should be able to detect from the prints that the lens employed was one and not the other.

The fallacy of supposing that the older types, such as R.R., were as good as modern patterns still exists, and is not made any less absurd by the admissions in the previous paragraph. It is only held by those who either have not had an opportunity of critically comparing the two, or else from defective vision—mental or ocular—are incapable of appreciating fine definition. "If an R.R. lens works at F/8, what is the advantage of an anastigmat also working at F/8 and costing six or eight times as much?" the author was asked quite recently. The reply, of course, was that if F/8 were used with both, the definition given by the anastigmat would, on the whole, be finer, or, put another way, the anastigmat might often be used at F/8 when the rectilinear would have to be stopped down to F/16 to get as good a result. Closely examined, the definition of a well-constructed anastigmat is distinctly superior to that of the R.R., even when the latter is very much stopped down.

In the very earliest days of photography, in 1841, Professor Petzval, of Vienna, realizing the importance of reducing exposure as much as possible, an importance far greater then than now, constructed his portrait lens of the type shown in Fig. 9. (The arrow in the case of all these lens diagrams points into the camera.) Most of the special portrait lenses used to-day are of this type, although modified in some respects. It will be seen that they are composed of three separate glasses. The front one is itself composed of two, cemented together. There is an air-space between the back pair, and if such a lens is taken to pieces, particular care should be taken to put each glass back in its proper place. To prevent all risk of confusion, a card should be cut to the curvature of each surface, and the position of that surface written on it as a record. Should the glasses then at any time get mixed, reference to the cards will enable the lens to be put together properly. Dallmeyer's patent portrait lenses are a modification of the Petzval form. These lenses are so made that by unscrewing them at the back and so increasing the separation of the two glasses, a certain "diffusion of focus," or softening, due to increased spherical aberration, can be obtained. Pictorial workers have found this a

A DUTCH CANAL

BY JAMES C. BATKIN

great convenience. Many like to use it to whom anything like "blur" is objectionable, because it is a curious fact, but capable of explanation, that when a slight diffusion is introduced all over the picture the result may look less objectionably "fuzzy" than when there is extreme sharpness in one place, and when the whole is sharper than in the previous case. But this only applies to a slight degree of diffusion, and a great deal can be obtained when required with the Dallmeyer portrait lens. An improved mounting is now made which allows the unscrewing to be done from outside the lens, in front of it, while other forms by means of rods and universal joints allow it to be done from the ground glass itself.

Most portrait lenses work at F/4 or thereabouts, but they have been made to work at F/2, or even at larger apertures than that. The great increase in the speed of plates has made portraiture possible with lenses of much smaller aperture, and those of the "portrait" type, such as we have been discussing, are now used chiefly by professional photographers. The amateur will either use his landscape or R.R. lens for portraiture, or, if he is pictorially inclined, will favour a long focus single lens, or perhaps such an instrument as the Dallmeyer-Bergheim. A portrait lens, as a rule, makes a good enlarging lens and is also excellent in the optical lantern. Such lenses have been used in hand-cameras, and for instantaneous work of special kinds, such as the photography of express trains; but their limitations in this direction are great, and those who wish to take up high-speed work seriously must be prepared to pay the price for a very rapid anastigmat.

Many references to the anastigmat have been made already, and it is possible the reader has come to regard it as a definite type, very much as the rectilinear, but it is not so. In the eighties Abbe and Schott, financially assisted by the Prussian Government, which was untrammelled by any *laisser faire* theories, carried out a long investigation on the subject of optical-glass making, which until that date had been in the hands of Parisian and Birmingham makers almost completely. The result was the establishment of the Jena glass works, which, making many new varieties of glass, succeeded in cornering the optical glass industry. This was the position reached when war broke out. Then, for aerial photography,

optical glass of the Jena varieties was essential; and British makers, with State encouragement instead of State neglect, were soon able to provide all that was needed. If they are left to fight it out fairly, there is no doubt that the British optical glass industry can hold the first position once more, as it did before 1880. It must be remembered that it only lost it when its German rivals were actively helped by the State.

The various new glasses referred to, are of widely different kinds, possessing an important range of qualities from the lens-maker's point of view. One of these qualities makes possible the reduction of the defect known as astigmatism to such an extent as to be practically non-existent. The lenses which take advantage of this are known as anastigmats. The methods of using the glasses to obtain this result are very varied, and the upshot of the change has been to substitute many widely differing designs for the comparatively simple R.R., wide-angle rectilinear, and portrait types, which occupied the whole field before the appearance of the anastigmats.

Little would be gained and a great deal of space would be occupied by an attempt to describe all these different forms. In most cases the lenses are doublets with the stop between them, and in some the two halves may be used separately, in others they cannot. The "Cooke" and the "Aldis" are examples of anastigmats of which the separate combinations cannot be used, except of course with an extremely small stop, when any lens can be used. The Cooke, which is the invention of Mr. H. Dennis Taylor of York, and is made by Messrs. Taylor Taylor and Hobson at one of the most perfect factories of the kind in the world, takes several forms. One, a very convenient hand-camera lens, is so arranged that the separation of the front and second glasses can be altered by turning a ring. This alters the focus of the lens, so that focussing for different distances can be carried out without any movement of the camera front or back. The "Aldis" is an extremely simple type of "anistigmat," which is comparatively cheap to make and is low priced but very efficient.

The "Stigmatic" of Dallmeyer is made in at least three distinct types, and is a very high-class anastigmat. The combinations *may* be used separately, and in this respect it

occupies an intermediate position between those which have just been named and those which are to follow. That is to say, the single combinations of the Stigmatic lens must be stopped down to about F/22 before they give as fine definition as that yielded by the complete instrument. One series of the Stigmatics works at F/4, and is a most efficient portrait lens, especially where space is limited; though it is, of course, preferable to use as long a focus lens for the purpose as possible.

The last class of anastigmats includes the Homocentric and the "Convertible" of Ross, the Holostigmat of Watson and others. These are all symmetrical, that is to say, they are composed of two lenses identical in construction and (sometimes) identical in size, placed back to back with the stop between them. Half the lens can be used by itself, the focus being then approximately doubled. Some of the lenses in this class represent the high-water mark of lens construction, and, incidentally, of lens price.

The question how far the quality which these high-class lenses possess is worth paying for, is not one that can be answered offhand. Even assuming, and it is a big assumption, that the more costly instruments do not in most cases give an appreciably better result than lenses of a less expensive nature, there is no doubt that they work at a bigger aperture, that under trying conditions they show their superiority, and also that they possess a market value as second-hand instruments very much nearer to their original cost price than is the case with the cheaper types. It is not an invariable rule by any means that the more expensive the lens the better it is; but as a rough guide price is not to be despised. Certainly it is not possible to make and supply at a low price a lens of both the quality and the adaptability of the modern symmetrical doublets; and the photographer who values definition and rapidity, will do well to buy the best lens to which his pocket will stretch. If he goes to any of the makers to whom we have alluded, he has at least the satisfaction of knowing that he gets an instrument made by a manufacturer with a high reputation to maintain, and that at the worst he should be able to get two-thirds or more of its list price should he make up his mind to part with it.

There is one drawback about the use of costly lenses, which may be guessed from a nocturnal expedition at which we once assisted, fortunately only to the extent of holding a lantern. It was one chilly autumn night, after all the regular inhabitants had retired to rest, when a small party of photographers went down to a certain village bridge. After preliminary observations, one of the party plunged into the river, and disported himself mysteriously for about a quarter of an hour. At the end of that time he emerged, cold, moist, but triumphant, with the front half of his anastigmat rescued from a watery bed, whither he had consigned it in the course of the afternoon while trying to get a long focus view from the bridge itself.

The demand for more and more rapidity has led to the construction of curious lenses at different times, one of the most remarkable in appearance being the Grun, in which the space between two of the combinations was occupied by fluid. This was not the first "liquid" lens by any means, an ingenious form having been devised by Sutton quite half a century ago for very wide angle views. These departures from recognized optical practice have proved more curious than successful; and the demand for an extremely rapid lens for kinematograph work, as the pictures needed were so small, has been met by the construction of modified forms of the portrait lens working at F/2 or thereabouts, and giving remarkably good definition.

Another curious lens was the result of efforts to provide an extremely wide angle instrument. It was known as the "Hypergon." No other instrument would approach it in the angle it would embrace, including 135°, and working at F/22. This means that the lens would cover a plate whose diagonal was five times the focus. The difficulty with all wide angle lenses is the very rapid falling off in the illumination of the picture as the edges are approached; and with such an angle as that of the "Hypergon," it became absolutely necessary to counteract this in some way. A little opaque disc, cut into the shape of a star, was delicately pivoted, so that it could be rotated in front of the lens by the air from a rubber bulb. The star obscured the centre of the lens, but allowed more and more

light to reach the parts of the lens as they were farther and farther from the centre. Were the whole exposure made with the star in position, the centre of the field would not have been illuminated at all; so that when seven-eighths of the total exposure had been given, a spring was touched, and the star dropped away from the lens altogether, the remaining eighth being given without it. For short exposures, the star was kept rotating by working the bulb; for long ones, such as in the case of interiors, there was no need to do this, the star might just be moved round a little at regular intervals. The drawing obtained with the "Hypergon" lens seemed at first sight most unnatural, because of the extraordinary angle it included. This quite unfitted it for pictorial work; but for ordinary record purposes, the lens could do what no other instrument would, and it was possible to get photographs with it in confined spaces where, before the advent of the "Hypergon," photography seemed to be impossible. For all that, it met no real want, and was little more than a curiosity.

In the early editions of this book, the telephoto lens was treated as a thing apart, a piece of apparatus which called for special skill in its use, and which was employed only by a few who specialized in that form of work. Since then the lens has been simplified, or, to be more correct, the demand for a simple form has been realized and has been met, as it could have been before if lens-makers had been alive to the demand.

The telephotographic lens consists of two parts, a "positive" lens, which may be almost any ordinary photographic lens such as we have previously considered, and a "negative" lens, which is placed between the positive lens and the plate. The "negative" lens is a diminishing glass, as the positive lens is a magnifying glass: the former is similar in kind to the spectacle used by a short-sighted person, the latter to the spectacle used by a long-sighted person. Two such spectacles in a tube, with the latter in front, form a telephotographic combination.

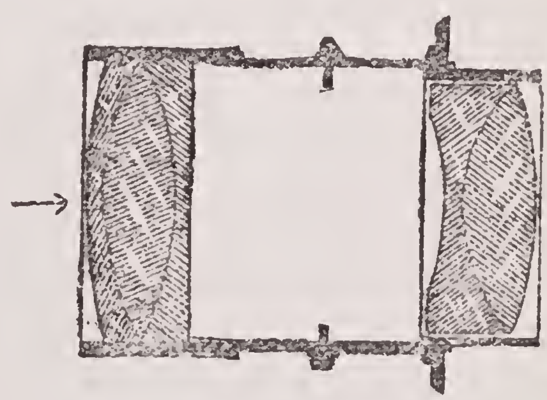

FIG. 10.—A TELEPHOTO LENS—THE "TELECENTRIC."

For practical work, it is of course necessary that the lenses

should not take this form, but should consist each of two or more glasses, so as to be properly "corrected"; but the case we have imagined will serve to show the telephoto lens in outline. When a positive and a negative lens are used in this way, provided they are suitably adjusted to each other for the purpose, we shall have a lens which will give an image on the plate in the same way as any ordinary lens. The effect of using the negative lens is twofold: first, it gives a combination which is longer in focus than the positive lens by itself, and second, this combination although it may be long in focus does not need the plate to be so far from the lens as would be the case were we using a lens of equal focus but not of the telephoto type. The result is that in the telephoto lens we have an instrument which gives pictures on a large scale (the scale of pictures from the same standpoint being in proportion to the length of focus of the lenses with which they have been obtained) but which does not require a long extension of the camera. This is very convenient, not only for photographing objects at a distance, but also for objects nearer at hand; and it must not be supposed, as might naturally have been concluded from the name of the instrument, that it is essentially a lens for photographing things that are far away. Any other lens, if of the same focus, will photograph such things just as well as, if not better than, a telephoto lens: but it would require a camera of great extension, and therefore the other is the more convenient.

There is another peculiarity about the telephoto lens which calls for mention; and that is that by altering the separation of the positive and negative lenses, the focal length of the combination is altered: so that such a lens, if it is provided with a means of varying the separation, is no longer an instrument of definite focal length. (This is not, strictly speaking, a peculiarity of the telephoto lens, although the property is more marked in its case; most lenses of more than one glass have their focus altered by altering the separation; but with one or two exceptions, it is only in the case of telephoto lenses that the property is marked enough to be made use of.) The consequence of this was that the early forms of telephoto lens, and some high-powered forms to-day, are made adjustable; and the photographer using them has a long or short focus

lens at will. In expert hands this property was a valuable one: but it had the curious effect of delaying the use of telephoto lenses by the general photographic public. Alteration of the separation meant alteration of the focus, alteration of the size of plate covered, and alteration of the F/- values of the stops. To the average camera user these were complications, often looked upon as prohibitive.

It was when makers realized that there was a public waiting for a telephoto lens which should be as simple in use as any ordinary rectilinear or anastigmat, that the popularity of the type became manifest. Some of the earlier patterns needed a good deal of stopping down to secure critical definition; but the "Telecentric" of Ross showed that it was perfectly possible to obtain as fine definition with a telephoto lens at F/5·4 as with the ordinary anastigmat. The "Telecentric" is made in two rapidities, F/5·4 and F/6·8, and has a focal length equal to about twice the camera extension required. It is coming into increasing use as a hand-camera lens; but in the longer focus forms, a reflex camera is a necessity with it, as the large aperture makes it very necessary for the focussing to be carried out accurately.

Such a lens as we have been describing is shown in Fig. 10. The glasses, seen in section on the right hand of the figure, form the positive lens, the other group being the negative. The separation being fixed, the focal length is fixed also, and so the iris diaphragm may be graduated with the F/- numbers and the lens used just like any other photographic lens.

The high-powered telephoto lenses used by experts are generally constructed to employ some ordinary lens, such as an anastigmat, or when rapidity is important a portrait lens, which is screwed into a special fitting carrying a negative combination, and allowing the separation of the two to be varied. When used on very distant objects, it is often difficult to get sharp pictures with them, owing to fluctuations in the density of the air, which cause the image to tremble. The haze or fog through which distant objects are generally seen, in consequence of the great thickness of dust or water-laden air through which they are viewed, also makes it difficult to get sufficient con-

trast. Then, again, the extremely narrow angle included in such high-power pictures gives a form of perspective which, in its way, may make the picture look just as incorrect, but in the opposite direction, as a wide-angle picture. These are not peculiarities of telephoto work, strictly speaking, but are due to the fact that we are photographing very distant objects. They would be encountered just the same if they were being photographed with an ordinary lens.

When telephoto lenses are used, owing to their long focus and large aperture, focussing, as just mentioned, has to be carried out very carefully. Owing to their construction, the optical centre of the lens does not lie within its mount, but in the air some distance in front of the lens; photography with them is therefore being conducted as it were at the end of a long lever, and the slightest movement of the shorter end—the lens—is greatly magnified on the plate. The apparatus therefore must be rigid, and must be held steadily or supported firmly.

The introduction of the telephotographic lens, if not its actual first invention, was due to the late T. R. Dallmeyer. He also introduced the "Adon," a simplified form of the lens, mainly used on hand-cameras and for small sizes. Another interesting telephoto lens of his construction is the "Dallmeyer-Bergheim." This last form is not corrected for colour, so that the definition obtained on the plate will not be the same as that seen on the focussing screen, unless, after focussing, the separation of lens and screen is altered to allow for this

Certain partly corrected lenses, of which the Port-land is an example, have come into use of late years, especially in America. They do not give fine definition, but a peculiar softness, with a kind of duplication of the outline in those parts where there are very strong contrasts. They are employed by some pictorial workers; but are, of course, unfitted for ordinary work from their inability to give a sharp picture.

THE FORTH BRIDGE

BY H. WILD

CHAPTER VII

THE LENS IN USE

The portrait lens—Single lenses—Using half a doublet lens—"Convertible" anastigmats of two and three foci—Rectilinears—The value of stops—The importance of parallelism—Focussing from the back or front—Copying—Depth of focus—Selection of a stop—Focussing landscapes—Interiors—Focussing by scale—Copying to scale.

THE lens in use calls for an application of the principles which have been laid down in the preceding chapters. The distinguishing titles—"landscape" "portrait" "wide angle" and so on—are only indications of the purposes for which the instruments are best fitted, and must not be supposed to indicate that the lenses cannot be used indiscriminately by those who do not mind the drawbacks such use entails. A portrait lens is one which works at a very large aperture, F/4 usually. As this means that the clear diameter of its lenses is one-fourth the distance of the lens from the plate, an 8-inch lens must be at least 2 inches in internal diameter, and so on in proportion. The portrait lens is therefore bulky and heavy. Apart from that, it works at a very large aperture, and therefore unless stopped down it has little depth of focus; but stopped down it makes a capital landscape lens, and, except for its distortion, it could be used even for architecture and for copying. For amateur purposes, the typical portrait lens is almost out of fashion, as the increased rapidity of plates has made it possible to do portrait work with much smaller stops than F/4, and consequently to take large heads and similar work direct with lenses which are neither excessively heavy nor large and therefore costly.

The single lens, which in its most elaborate and perfect form is composed of three or four distinct glasses cemented together, and works well at F/11, is perhaps the best all-round

instrument for its price that can be obtained; but it is better to buy it in the form of a doublet, which may be either a rapid rectilinear if the pocket is limited, or an anastigmat if it can be afforded. Rectilinear lenses and most anastigmats can be used either as a whole, when they work at from F/4 to F/8, or F/11, according to design, construction, and angle included, or one half may be unscrewed and the other used by itself. In rectilinear lenses, which work as a whole at F/8, the foci of the two halves are generally approximately equal, though hardly ever exactly the same. At least the difference between them is not marked enough for them to be regarded as giving the photographer much choice between them. It is customary to unscrew the front lens and use the back one, and this is easily done without taking the lens out of the camera. Even if the front lens is that which is used by itself, it is better to put it between the stop and the plate than to leave it in its original position in front.

Half the lens used in this way gives a picture on something less than twice as large a scale from the same standpoint, and this is often a great convenience. With "wide-angle rectilinears" there is usually a greater difference between the foci of the two halves; but as this differs not only in different patterns, but even in individual lenses of the same pattern, the photographer will find it best to ascertain for himself whether the two are alike or not.

Some anastigmats are constructed so that the single lenses are corrected to such an extent that it is difficult to detect any difference in quality between the single lens and the combination of two, except as regards rapidity. If the single lenses are equal in focus, the combination may work at F/6 or thereabouts, all the single lenses working at F/12. If the lenses are of different focus, the combination is not quite so rapid, being slower the greater the difference between the lenses. Thus we may have a 9-inch single and a 14-inch single, both working at F/12·5, the combination being one of $6\frac{1}{4}$ inches, working at F/8. If instead we took two $11\frac{1}{2}$-inch lenses, the combination would have practically the same focus, but would work at F/6·3. The extra rapidity is worth having for some purposes, but unless hand-camera work is to be done, it would certainly be better economy to get the first pair, as it would give three lenses of

9, 14, and $6\frac{1}{4}$ inch respectively, rather than two, an $11\frac{1}{2}$ inch and a $6\frac{1}{4}$ inch.

With such instruments, as with rapid rectilinears, straight lines in the original should be rendered as straight lines in the photograph when the double lens is used. With the single lens there will be a certain degree of distortion when such straight lines occur near the extreme edges of the plate. This is much less with the anastigmats than with the rectilinears, though with neither should it be noticeable unless looked for or the conditions are very trying. Such single lenses make excellent portrait lenses, when exposures can be long enough, and they will always cover at least as large a plate as the combination, generally one much larger. Thus the 9-inch lens just referred to might cover a plate $7\frac{1}{2} \times 5$ inches, the $11\frac{1}{2}$ inch a whole plate, the 14 inch a 10×8, whereas either of the $6\frac{1}{4}$ inch combinations might not be fitted for use on anything larger than a half-plate unless stopped down.

Whether the lens be an anastigmat or a rectilinear, one thing must not be overlooked, and that is the alteration in the values of the stops and therefore in the exposures, when half the lens only is being used. If the focus of the single lens were exactly double that of the combination, all exposures with the former would require to be four times as long, since the stop of the combination marked F/8 would be F/16 with the single lens, F/11 would be F/22, and so on. Such an exact doubling can hardly ever be the case, and it will therefore be well to find out the values of the different stops for the single lens, if they are not already marked for it. With an iris diaphragm it is better to have it separately engraved for the single lens and for the double, making the distinction between the two scales quite unmistakable to prevent accidents.

Whatever the lens be, its quality is quite wasted unless the camera front which bears it, and the camera back which carries the plate, are normally strictly parallel. This ought to be the case with every camera, unless of the most slopmade and shoddy construction; but to make sure as far as possible that it is so, the camera should be opened out, fixed on the tripod, and its front made as strictly vertical as it is possible to get it, plumbing it with a thread and bullet. In doing this the lens should be in position, lest its weight should throw things out again. When

the front is plumbed, the back tested in the same way should also be plumb. The camera may then be laid on its side, and the front again carefully made vertical. Wedges will probably have to be used, unless the camera is one that is turned on its side to reverse the way of the plate, as it will not be possible to screw it to the tripod. The back is then again tested in its new position.

To focus an object the camera is racked in and out. In most landscape patterns the front carrying the lens is moved by the rack, the back also having a sliding movement; but in square bellows patterns the back often moves and not the front. The difference is not unimportant. In landscape work, when the nearest objects are many times the focus of the lens away from the camera, the fact that when we rack the lens in or out we not only alter the distance between the lens and the plate, but also between the lens and the subject, does not make an appreciable difference. If we were copying or doing other work with the subject nearer to the camera, this alteration of the distance of the lens from the subject might be a great nuisance. For copying work, portraiture, etc., therefore, a camera which focusses by the movement of the back is to be preferred. Where the exact size of the image on the screen is not of very great importance, focussing can often be carried out more accurately by using the rack for rough focussing and sliding the camera to and fro to secure the final focus. In such work it is often a help to use a focussing glass, a little magnifier, which is adjusted by pressing it on the ground glass and screwing the lens of the magnifier in or out until the ground surface of the glass is seen at its sharpest. The magnifier must not be altered afterwards, and must be pressed against the focussing screen when it is in use.

Most of the defects which were dealt with in Chapter III. are remedied by the use of a small stop; but the stop plays an important part in another direction. We have seen that there is with every lens a position for the ground glass in which the image of an object at a certain distance from the lens is sharp, and that as the distance of the object varies so the distance of the ground glass must be altered. It would seem then that it is not possible for two objects at different distances to be sharp at the same time. Strictly speaking, this is so; but as "sharpness"

is a matter of degree, when one object is sharp another at a different distance will not be so sharp, but may still be well defined enough to appear equally sharp to our eyes. The more a lens is able to render near and distant objects equally sharp at the same time, the greater is said to be its "depth of focus." Unfortunately this most desirable quality is not a matter of design, but is dependent upon the focal length and the size of the stop. A salesman anxious to dispose of a lens will sometimes claim for it that it possesses "great depth of focus." He means nothing by it; it is only an idle boast. Did he mean anything, it could only be that the lens would not work at so large an aperture as another with less depth of focus. And aperture, *aperture*, APERTURE is what the optician is ever striving for. Not to make a "better" lens, but one as good that shall work at a larger aperture, is his constant aim.

Large apertures in large lenses mean great lack of depth of focus. An example should make this plain. A lens of 4½-inch focus working at F/8 will give us sharp images of objects at 11 feet and upwards to infinity. If we stop it down to F/16, objects 5 feet 3 inches and upwards will be sharp. But if instead of our 4½-inch lens we have a 12-inch one and use it also at F/8, instead of getting everything sharp from 11 feet upwards, the nearest object that we can get sharp at the same time as the distance will be 75 feet from the camera, or at F/16—37 feet. Of course we can focus nearer objects by sacrificing the distance, but there will always be that wide disparity between the depth of focus of the lenses. This we must not forget is not a matter of the make of the lens, or the perfection of its design, but is a shortcoming of the ideally perfect lens, as much as, or even more than, of an inferior one. Because the worse the lens, the more likely is its want of depth to be lost sight of in its other imperfections.

We stop down, therefore, to reduce as much as possible the faults of the lens, and also to get the depth of focus which the subject demands. Next in importance to the operation of focussing is the selection of the stop. Many workers, beginners especially, in their desire to secure the sharpest possible definition, use much too small a stop. A good rule is to employ the largest aperture that will give the degree of sharpness required. The use of very small stops tends to make the negative flat and

-king in contrast, and deprives the picture of a certain proportion of its relief, due to the rendering of the different planes with different degrees of sharpness, which with a large opening may be effective, even when the degree of blurring is not great enough for it to be noticed at all. Absurdly small stops introduce diffraction phenomena, and so make the definition worse instead of better; while with certain types of lens a change in the size of the stop introduces a change in the focus, and it is therefore necessary to focus with the stop that is to be used to take the picture. This is just what the "small stopper" tries to avoid; he does not like the responsibility of deciding by the eye alone whether the stop is small enough. Yet this ought always to be done, and the photographer should satisfy himself not only that his picture is as sharp as he wants it to be, but also that he is using the largest stop that will make it so.

Landscape subjects and architectural exteriors are the easiest to focus. Portraits are more difficult, and need watching to see that nothing which in the dark corners of the focussing screen is overlooked, will be offensively blurry in the brilliant print. Interiors are hardest of all, because, as a rule, they are so poorly lit that the importance of keeping the exposure short cannot be passed by, while the great difference in the relative distances of the different parts calls for careful focussing with the actual stop used.

Focussing by scale is considered in the hand-camera chapter, but with stand-cameras there is one form of scale which may be adopted. The usual lens being put in place, a distant object such as a lamp 300 or 400 yards away, should be sharply focussed with the open aperture, and the position of the moving part of the camera, front or back as the case may be, is marked with the blade of a knife and a little soot or other black rubbed in to make the cut easily visible. It is at times a convenience to be able to open out the camera to "infinity" without looking on the screen; and if we want a case in point we might take that of a heavy thunderstorm at night. The photographer suddenly realizes that he has a magnificent opportunity of getting some lightning photographs, he extends his camera to the mark, as we have described, he cannot focus, there is nothing on which to focus, he puts in a plate, uncaps the lens, and points it to the quarter of the sky

in which there seems the best chance of a flash. After one or two have taken place, the plate is changed, and the operation repeated as long as the supply of patience, plates, or lightning holds out.

A scale on the base board is also very useful when copying to some exact proportion has to be done. Without it the task becomes a very irritating one, because every alteration in the focus to get the subject sharp alters its size. When it is the right size it is not sharp,—we carefully focus it only to find that in doing so we have altered the dimension of the image ; we get this right, and then the picture is no longer sharp, and so it goes on. By marking the camera extension on the base board, once for all, for the usual copying lens, for images of different proportions to the original, all we have to do is to open out the camera to the right mark and clamp it there, and then to focus by altering the distance between the camera and the subject.

CHAPTER VIII

PLATES AND FILMS

Glass *v.* Celluloid—Paper for negative work—Commercial plates, British and Foreign—Different kinds of the same make—High rapidity—Orthochromatic plates—Halation, its cause—Prevention—The manufacture of caramel—Development and halation—All halation not a defect.

THE ideal support for the sensitive coating which we expose in the camera is still in the future. Glass has many advantages; the ease with which it can be obtained smooth enough for the purpose, its cheapness, its inert behaviour in the different solutions used by the photographer, and its transparency. This last quality it does not possess to the extent many people imagine, and even to the eye clean glass cuts off much light, while to the photographic plate, which is sensitive to light the eye cannot appreciate, it cuts off a great deal more. On the other side of the account we have the rigidity of glass, an advantage or disadvantage according to circumstances; we have its brittleness, a decided drawback, its weight, and its thickness. This last is the prime cause of that bugbear of the photographer—halation.

The only serious rival which glass has at the present time is celluloid. This can be obtained clear enough for all ordinary photographic purposes, very thin, flexible, practically unbreakable, light; but until recently it was more expensive. Now the price of plates and films is very much the same: in some large sizes cut films are even cheaper than glass plates of the same size. Celluloid film enjoys a very wide popularity amongst amateurs, as its good qualities are particularly in evidence when work is to be done away from home. The roll film with its facilities for daylight loading and daylight developing makes photography facile to a degree. The film takes up little room, is light, and travels safely by post.

THE RIVER AIRE, AT LEEDS

BY J. CROISDALE COULTAS

It is a curious but well-attested fact, that it has not hitherto been possible to make roll films as rapid as plates. The same emulsion spread on glass and on celluloid is markedly more rapid in the former case. Moreover, volatile substances enter into the composition of celluloid, and though the precise nature of the action is not understood, celluloid films will not keep so well as plates, especially under trying climatic conditions. Celluloid also is highly electrical, and when circumstances are favourable, it may be caused to spark in such a way as to affect the sensitive coating on it. Rapid rolling or rubbing is most likely to bring this about, and in manufacture it has caused a great deal of trouble, especially in the early days of the industry. We hear of sparks a foot in length flashing about the coating-room as the film was stripped from the tables, where it must have acted like a great electrophorous. But forewarned is forearmed, and by handling roll film with reasonable gentleness, there should be no trouble from such a cause. Its inflammability is not so great as that of bare celluloid, the non-curling film, which has a coat of gelatine on both sides of it, being to some extent fireproofed thereby, although it will burn if a little trouble is taken to light it. Celluloid is not so inert as glass, and certain solutions which would not affect the latter, must on no account be applied to a film. Thus it is not practicable to dry celluloid film in a hurry by means of spirit; though this is the only case that need be mentioned. Celluloid films in large sizes need certain precautions to keep them flat, and even in postcard size a flat field lens, working at a large aperture and sharply focussed, would hardly be likely to give such crisp definition all over a film as it would on a glass plate. The inferiority would only just begin to be perceptible in this size, and in anything smaller it need not be taken into consideration.

While glass and celluloid divide between them the honours of the situation, they are not entirely alone. Paper, especially in large sizes, has its advocates. Some workers make their enlarged negatives on ordinary bromide paper, while others have used this for outdoor work with the camera. The sensitive coating on ordinary bromide paper, however, is kept thin to suit the paper to its true purpose—printing and enlargement. When it is used for negative making, this thinness means that

the exposure must be exact if the negative is to be a good one. Some makers of bromide paper, therefore, have put a special "negative paper" on the market, which is essentially a bromide paper with a thicker coating of emulsion than usual. The cheapness and lightness of paper make it attractive to landscape photographers who work large sizes direct. The grain of the paper itself shows slightly in a print on a smooth surface; but in carbon or rough platinum it is not noticeable. The paper slows printing considerably—four or five times at least—unless it is waxed; but it is better not to wax it, as there is always a chance that it may take the wax irregularly and in spots. The best material for the purpose is a mixture of one part of Canada balsam and five parts of turpentine. This is rubbed into the paper with a small sponge, and the negative is then hung up for the turpentine to evaporate. One advantage of a paper negative is the ease with which one can work upon its back with pencil, stump, and brush; against this may be set the ease with which the paper will absorb noxious solutions and stain, when celluloid or glass would allow them, literally, to run "like water off a duck's back."

A material, which is now no longer available, but which was very greatly appreciated by some workers, was known as "Cristoid" film. In this, the support itself was of gelatine. The feature of the film, which was very valuable for certain purposes, was that it was double—in some cases treble—coated. The slowest emulsion was coated first, and then a faster emulsion on the top of that. Such an arrangement gives enormous latitude. No double-coated plates are now on the market; but we understand that they are occasionally made by at least one maker for his own use, and his more favoured friends are allowed a supply. No doubt, if anything like a general demand were made for them, they would be commercially obtainable.

Enough has surely been said to enable the reader to balance the *pros* and *cons* of films, plates, and papers. The author's own practice is to use plates exclusively for work at home, or where their weight is not prohibitive. As his photographic touring is limited to a few weeks in the year, he uses plates then, in spite of the difficulties of carrying about a supply. Films are used in a folding-camera on journeys

when photography is not the *raison d'être*, the compactness and portability of the outfit preventing it from being a serious addition to the luggage. Any one who uses the camera for travel purposes exclusively, would find the advantages of roll film almost irresistible. For professional photography, and for amateur work at home, the rigidity and perfection of glass, to say nothing of its economy, offer overwhelming advantages to those whose apparatus will admit of its employment.

At the present time there are many plates on the market; amongst which the photographer can choose for himself, with little fear of making a bad selection. If the number of good plate makers is legion, the number of kinds of plates is at least half a dozen times as great, for every maker has several brands. One, usually at a higher price, is the fastest of all, and this is the plate which should always be used for hand-camera work. This is not to say that no other plate is possible; but that, as the conditions cannot be foreseen, it is good policy to be prepared for the most unfavourable. In the early days of gelatine plates, fast plates were much more difficult to develop than slow ones; they were sometimes only the slow ones fogged to make them seem fast, although this deception was quite an unconscious one on the part of the plate-maker. That reproach is now entirely removed; and, except that there is more risk of fogging them by undue exposure to the light of the dark room, the fastest plates of all are as easy to develop as those of ordinary rapidity. Sir William Abney, who has photographed a great deal in Switzerland, recommends very fast plates for use there, on the ground that they yield a softer and more harmonious negative of subjects in which the contrasts are excessive, as is the case with Swiss landscapes. For portrait work the fastest possible plate should be used, because the lighting is often none too great, and it is always well to keep the actual duration of the exposure as short as possible, in the interests of the sitters themselves. Moreover, a portrait negative must on no account err on the side of excessive density, and this is less likely to occur with a fast than with a slow plate. Most photographers, who turn to portraiture from landscape, get their negatives too strong at first. The special plates made for portrait purposes are not different from others

in any respect except in the character of the gradation which they give, this usually being softer in the portrait plate.

Very rapid plates are not to be recommended except when their speed is a necessity. Slower plates have a more opaque film, an advantage referred to again later on, and they possess a greater "range." That is to say, assuming with a slow plate that an exposure of two seconds is the shortest that will give a correct negative, eight or even sixteen times that exposure may still give a correct negative, as will be considered when we come to discuss exposure. On the other hand, with a very fast plate, if two seconds is the shortest correct exposure, four times that is probably the greatest exposure that would also be correct, anything more giving rise to signs of over-exposure in the negative. For landscape and outdoor photography in general, when a stand camera is used, a plate of ordinary rapidity is all that is required. For interiors the slow plate is often an advantage in spite of the increased length of exposure, because of its greater range and thicker coating.

It is in this direction that double- or treble-coated plates and films possess such an advantage. The layers of emulsion do not separate, and the finished negative shows no sign of them, but the light which passes through the rapid emulsion on the top does not merely pass out of the plate, but some of it is absorbed and utilized in the layers beneath. Hence such plates have a range which no single layer of emulsion can approach.

The question whether or not he should use orthochromatic plates is one which the photographer must settle for himself, according to the character of the work which he proposes to do. Theoretically, no doubt, in almost every case, they are superior to ordinary plates; in practice, this superiority is often quite incapable of detection. This is dealt with at length in the chapter on orthochromatic work.

When a photograph is taken of some subject in which there are great extremes of light and shade, such as an interior with a brightly lit window which appears in the picture, a defect often makes its appearance in the form of light in the print, all round the bright object. There is a certain glare in the subject itself, caused by the illuminated air—or rather the illuminated dust in the air; but the photograph may show a great deal more than exists in Nature. The cause of this can

be understood from Fig. 11, which represents, very much magnified, a section through such a negative. A is the glass plate, and B the film on its surface. A ray of light, C, coming from the lens falls on the sensitive film at K, and some of it is absorbed. But a plate is not perfectly opaque, as we know, and some of the light passes through it to the glass, A. The top surface of the glass will reflect some of this light, as shown by D, the bottom surface will also reflect some, E, and the rest will pass out at the back of the plate towards F. The thicker and more opaque the coating B on the plate, the less light will get through it. Some of the light from C, on entering the film, will also be scattered in all directions by the particles of silver bromide, as shown by the finer lines G, G. It will be noticed at once that the reflected ray E reaches the film in a spot, H, some distance from K, that at which C struck it, and therefore while the true image is formed at K there will be a certain quantity of light-action at G and H also. As a matter of fact, light will be reaching the film all the way from K to H, owing to reflection and scattering; but the diagram has been kept simple for the sake of clearness.

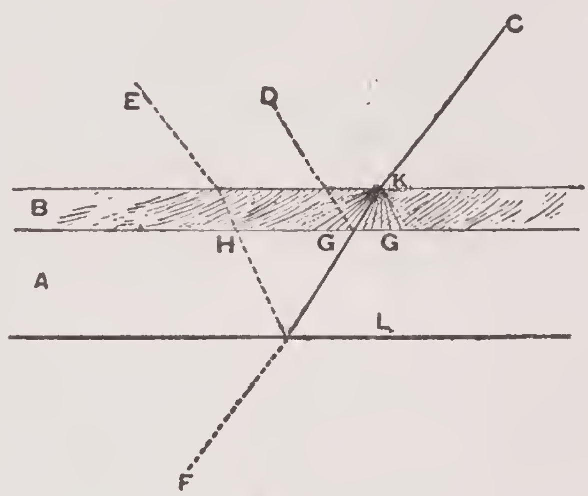

FIG. 11.

A little consideration shows that as B is extremely thin, the reflected ray D will lie close to K while it is in the film, and so will not give rise to any serious spreading of the image. In the same way, little trouble is likely to arise from G, G, G. These are the only causes of halation in celluloid films, and consequently the defect is almost unknown with such materials. But with glass plates the case is different. The back surface of the glass at L is highly reflective, and, owing to the thickness of the glass, H is often at some distance from K, and the light reaching H causes a distinct fogging of the film there, and therefore in the print causes the glare which is only too familiar to photographers.

There are two methods by which halation can be attacked, and if both are invariably employed, it will entirely cease from

troubling. The first is by means of "backing." This is a preparation which is spread on the back of the plate at L, by which its power of reflecting light is destroyed The action of backing is one which is more often misunderstood than almost any other photographic process. Many people suppose that any opaque substance spread upon the glass at L will answer the purpose. This is a complete mistake. Most of such substances will merely absorb the light which is passing away to F. But this light, if the plate is in a darkslide that is properly blackened inside, is already harmless, and whether it is absorbed by a coating on the plate or by the darkslide is quite immaterial. Black paper gummed to the glass, or black velvet laid against it, are some of the devices to prevent halation, which have been suggested from time to time by some who did not understand the nature of the problem. They are useless for the purpose. It must be remembered that the light which does the mischief at H never gets outside the glass A at all, and anything that is to attack it must do so from within, as it were. This is not so impossible as it seems at first sight. We can apply to the glass at L something which, by being almost identical optically with the glass itself, causes L to cease to exist as a reflective surface. To do this, the substance applied must have the same "refractive index" as glass, or as nearly the same as possible, and it must be applied in "optical contact" with the glass. It will then stop reflection from L, the light which would be reflected passing into the substance, whatever it is, where it must be absorbed if it is to be rendered harmless. There is one material which seems better fitted for backing than any other, and that is caramel. It is the basis of most of the preparations on the market, and is most efficient. Backing may be applied with a sponge, a brush, or a dabber made by tying up a tuft of cotton-wool in a piece of cambric. A little piece of artificial (rubber) sponge makes an excellent tool for the purpose. If many plates are to be coated a backing frame is convenient. It is easily made of card or wood, and is simply a board with a ledge just a trifle smaller than the plate, and on this ledge another into which the plate fits. The plate is supported in such a frame, face downwards, and except at the extreme edges its face is not in contact with anything, and therefore cannot be damaged. The backing is rubbed on, and

the plate placed in a rack for it to dry in the dark. If the plate has to be put into the camera at once, a piece of tissue-paper may be placed on the backing and rubbed into contact all over. A thick coating of backing is quite unnecessary, nor need it be even in thickness provided it goes all over the plate. The best workers use no plates, whether for direct negative work, for slide making, or for enlarged negatives, that have not first been backed.

There is still the second method of the prevention of halation, which is by suitable development. In the diagram which follows, Fig. 12, we have supposed the plate shown in Fig. 11 to have been fully developed, and the image in its magnified film is shown by the shading. The letters are the same in both, but the course of the rays of light is not marked by lines, being unnecessary. It will be seen at once that the halation at G and H starts from the glass and works up into the film, while the true image at K starts at the surface and diminishes downwards. Hence, if we could plane off the under part of the film, say all below the dotted line, we could get rid of the halation almost entirely. These are not suppositions. Sections of films have been cut and examined in the microscope and the positions of the direct and halation images actually *seen*. Moreover it is possible, if not to plane off all below the dotted line, at least to keep the image mostly above it. This is done in exposure and development. The longer the exposure the more the image at H approaches the surface of the film, and the more the image at K extends down towards the glass. Over-exposure, therefore, tends to increase halation. Prolonged development also, by giving the developer time to diffuse down and act energetically on the glass side of the plate also helps to make halation more apparent. Hence developers which contain bromide to any extent give halation when otherwise it might be absent; while under-exposure, by inducing the photographer to go on developing in the futile hope of "bringing out detail," is as efficient a cause of halation as anything can be.

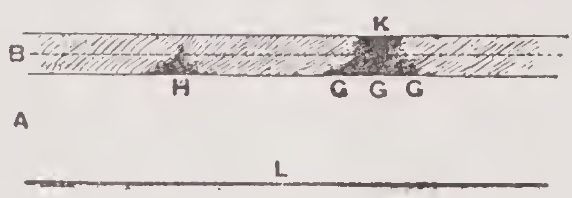

FIG. 12.

If a subject is likely to give rise to halation, therefore, we can prevent it from being troublesome—

1. By using a thickly coated plate—slow plates, as a rule, are more opaque than fast ones, and therefore appear more thickly coated, and actually are less liable to halation in consequence.

2. By using a properly backed plate.

3. By exposing correctly and developing without any restrainer.

A photograph taken under these conditions, however trying the subject, should show no more halation than is visible to the eye.

FRANK BRANGWYN

BY ALVIN LANGDON COBURN

CHAPTER IX

THE DARK ROOM

The dark room should be a room, but not dark—Necessity for occasional daylight—Illumination—Light filters—Coloured glass—A "liquid lamp"—Light for different purposes—For orthochromatic plates—Fabrics—Testing the light—The sink and water supply—Splash preventers—Shelves—Dishes, porcelain or otherwise—For large work—Measures and scales—A light-tight drawer.

IT is possible, by using roll-film and a developing machine, to dispense entirely with the dark room, but this is to impose very narrow limits upon the photographer, and a majority of those who use such appliances have probably some form of dark room. In a great many cases it is a place of such a character that good work becomes almost an impossibility. Narrow, cramped, ill lit, and worse ventilated, it is a prison from which the perspiring captive emerges with a sigh of relief, instead of the clean, comfortable, and (comparatively) brilliant room, which it might be. The idea that any little corner will do, provided it is dark, is responsible for much of the discomfort of the average room; and the truth is not realized, that it is better to turn an ordinary room into a temporary dark room when required, than to have a chamber from which all daylight is permanently excluded. Not only is a room which is never entered by daylight distinctly unhealthy, but it is almost certain that it will not be kept so clean, as if its dust and dirt revealed themselves under the searching influence of the sun. And dirt, using the term in its widest sense, is the greatest foe the photographer has to encounter.

Dirt in the camera, dust in the slides, chemical dust floating in the air of the dark room, invisible but by no means imperceptible dirt in dishes and measures, all lie in wait for him, and all make their presence felt by defects, whose precise

cause it may be difficult or impossible to trace. It is only when we deal with so exquisitely sensitive a thing as a plate, that we realize the true meaning of cleanliness. Let a spirit-lamp be burning with an almost invisible blue flame, and tap the table sharply. It starts into a yellow light for an instant, and the spectroscope tells us that we have jerked into the flame some of the ever-present dust containing sodium. The plate is not quite so sensitive as this, and sodium salts are not its worst foes; but few dark rooms are free from other chemicals in the form of dust, and one of the most prevalent, as it is the most deadly in its effects, is hypo. This salt, at once the photographer's best friend and worst enemy, has a most searching character, especially in solution. It is hardly too much to say that it is impossible to remove all the hypo from a porcelain dish in which a fixing solution has been left for four and twenty hours. At least it is only possible to do so by devices to which the photographer is not likely to resort. For this reason, porcelain dishes used for hypo should be used for nothing else. It may not affect the solutions generally employed for development, but a trace of it will put a gold toning bath out of action in a very little time.

If dust is a foe to the plate user, it is still more so to the plate maker, and we therefore see that plate factories are established in the country to get away as much as possible from the smoke-laden air of the towns. In the olden times, when photographers had to make their own plates, there was one process, the albumen, which was used for transparency making. It was said to be so sensitive to dust, that enthusiastic slide makers used to remove their garments, rub themselves all over with glycerine as if they were Grecian athletes, and grapple with the process in nature's garb alone. How far this is true, or whether it is one of those myths from which no early history is quite free, there is now no telling. Let us be thankful, especially in winter time, that the exigencies of modern methods are less exacting.

The power of flooding the dark room with daylight, then, is worth keeping as a guarantee against dirt. It should be roomy, to prevent semi-suffocation. The author has long held to the belief that no dark room at all is better than a small, ill-ventilated cupboard. As a rule, it is not difficult to

provide a frame covered with some light, opaque material, by which, without much exertion, a window can be blocked up when required. By limiting dark-room work to the evenings, even this may not be necessary. Moonlight shining into a room does no harm provided plates are not directly exposed to its rays. A water supply and a sink are the two most essential fittings, but even these can be extemporized. If much work is to be done, however, they must be provided.

It is difficult to lay down rules for fitting up a dark room, as the conditions of different cases are widely different; but a few general principles may be given. If the dark room is a large one, and electric light is used, there is not so great a need for special ventilating arrangements to act when the room is darkened; a fireplace and chimney will do most that is required. But small rooms lit by gas should have their ventilation looked after most particularly, or the photographer will suffer. There is a form of headache which many people think is brought on by working in the red light; it used to be attributed to the ammonia that was used for developing. Its real source is to be found, there can be no doubt, in a lack of sufficient pure air in the dark room. Many otherwise efficient ventilating systems are rendered almost useless by the light trap. Air should pass through the ventilator, but no light. Air can turn round corners and light cannot; therefore, a few corners in the ventilator are sufficient to prevent light from entering. But if air can turn corners, it requires a certain pressure to make it do so, and every corner tends to obstruct the passage, even for air. A light trap, therefore, if placed in a passage otherwise the right size, should be an expansion of that passage; or the fact that an opening is light trapped should be a reason for making it bigger than would otherwise be necessary. However well ventilated, in every good dark room it should be possible to fling open the windows and let in fresh air and daylight with no trouble at all.

The illumination of the dark room must depend necessarily on the work to be done in it. The red lamps at present on the market are, almost without exception, too small; and are suitable only for temporary dark rooms and makeshifts. The user has to pore over his dish close to the lamp, or else work

in semi-darkness, which is most injurious to his eyes, and is demanded by very few plates. Moreover, the limited quantity of light makes it impossible to find anything not quite at hand, and is responsible for measures and bottles being knocked over and broken. Where electric light is available, an efficient and safe light is a very simple matter. Stained incandescent lamps are not satisfactory and should on no account be used. The heat of the lamp soon affects the coating, and its light causes the dye to fade, and the lamp becomes a danger. One of the circular glass jars which one sees in the windows of sweet-stuff shops forms as good an electric dark-room lamp as can be wished. The bottom and about an inch above it are made opaque by being covered with black paper or bookbinder's cloth, and a cardboard lid, with an edge about an inch deep, is also fitted. Through the centre of this lid passes the flexible wire from which is suspended the incandescent lamp. The exterior surface of the jar may be covered with any selected flexible coloured medium, which may be provided so as to slip on and off, or be fixed in position. Or the jar may receive a coating of coloured varnish. Or a liquid lamp can be used as described subsequently.

Let us consider for a moment what the problem of dark-room illumination presents to us. Plates, even non-orthochromatic, are sensitive to light of every colour that is perceptible to the eye, and very sensitive to "ultra-violet" light also, of which the eye is hardly conscious. We must not forget that even a "safe" red light will fog any plate in time. The light to which non-orthochromatic plates are least sensitive is deep pure red. Crimson often contains "ultra-violet," and may be most unsafe in consequence. To yellow light plates are a little more sensitive, to green they are a little less sensitive again, while by blue and violet they are immediately affected. Green, yellow, and red, therefore, are the three colours amongst which our choice may be made. Red, considered solely from the point of view of the plate, is safest, but the least luminous to the eye. Orange, which may be regarded as a mixture of green, yellow, and red, is in consequence favoured by many people. The trouble about orange is that it is certainly not safe for the orthochromatic plates and films which are now coming into general use, and so far as the author is aware, there is not on

the market any orange-light filter which has been worked out for the purpose of dark-room illumination, so as to give a light at once as bright and as safe as possible. This is not the case with red, and there are several forms of light filter of this colour, which have been fitted to the work they are required to perform, and not selected haphazard. They are carefully adjusted to give the greatest quantity of light that is consistent with safety, and being made in several forms can be selected for the various requirements of the photographer.

The writer's own dark room is one in which such type as that on this page can be read quite comfortably, in any part of the room, although at the same time the fastest non-orthochromatic plates can be developed without fog, in a dish left uncovered for at least a minute. The main light consists of two large glass beakers, fitting one inside the other with a space of about a quarter of an inch all round between them. The two are cemented together at the bottom with cobbler's wax. The inner beaker contains a 32-c.p. metallic filament electric light; and the space between the two is occupied by a solution of three ounces of potassium bichromate and one dram of eosin in a quart of water. Hot water is used to make the solution, and the mixture is carefully filtered when cold. This lamp gives a brilliant red light, and stands on a little wooden shelf eight feet from the floor, so placed that the shelf prevents any direct light from the lamp shining on the developing bench. The room is papered in white, so that as much as possible of the red light is reflected. If the density of a plate is to be judged by looking through it, a second lamp with a deep red "safe-light" and a 16-c.p. metallic filament lamp at one end of the work-bench is also used; but this is not needed for any other purpose, as the top light is ample. For bromide paper work the lower lamp is also used, the deep red "safe-light" being replaced by a bright yellow. It will give some idea of the strength of the light given by the liquid lamp, when it is mentioned that when enlarging on the opposite side of the room, with a lantern, the red light has to be switched off in order to make the room dark enough to focus properly. Red sensitive or panchromatic plates are best developed by time in complete darkness; orthochromatic plates of other kinds can be developed in the

room with the liquid lamp, all that is needed being a little more care in keeping the dish covered over except just when it is necessary to see the plate. In any case it should be made a rule never to expose the plate to the direct light from the lamp unless for the express purpose of examining it. Thirty seconds in all should be quite long enough exposure during the development of a negative.

So far nothing has been said about coloured glass for dark-room illumination. As a matter of fact, though it is widely used, it is not to be recommended. The ruby glass is "flashed," that is to say a thin film of red glass covers one side of a sheet of white glass. The colour is a good one for ordinary plates, but nearly all orthochromatic plates are distinctly sensitive to the light transmitted by ruby glass. In addition to this, pinholes in the ruby coating are not at all uncommon, and while they may not be visible to the eye, they help to make the light unsafe. Some ruby glass lets through a considerable proportion of ultra-violet light, and is most unsafe in consequence. Yellow glass, as such, does not exist. The yellow glass on sale is not yellow but brown, as can be seen by putting a piece of it down on a sheet of white paper. It is therefore darker than it need be, without being any the safer. It is "pot" glass, that is to say the yellow colour is not in a thin layer, but extends right through the glass. It is therefore not subject to pinholes. If glass is used in a lantern, a sheet of yellow and a sheet of ruby make a reasonably safe combination, though not a very light one. The yellow does not make the ruby seem much darker, but it makes the light distinctly safer. If the "safe-light" or glass is transparent, the lighting of the dark room is made much more pleasant by the use of a sheet of ground glass. This diffuses the light and throws it into corners otherwise quite dark, while it lessens at the same time the strength of the direct rays.

There are various fabrics on the market for dark-room illumination. Of these ruby and canary medium are well known. They are a stout woven material prepared with some coloured coating which makes them fairly safe when two or three thicknesses are used. (One thickness is never safe, on account of pinholes, which are quite unavoidable.) As they are comparatively cheap, they are often used to block up windows,

so as not to exclude all the light, and for this purpose they are well fitted. The author some years ago did a great deal of developing in a little dark room partitioned off an ordinary room. It was a light wooden frame, covered entirely to within 2 feet 8 inches of the ground with one layer of ruby and one of canary fabric, the doorway being closed with a curtain. A paraffin lamp stood on a table outside, and the light within was very pleasant and uniform, though not very strong. Another material often employed is known as "Ruby Christia." This is made both in paper and fabric, and can be used for the same purposes as the ruby and canary medium. Its colour is, if anything, better. The paper is an excellent material for tourists, as it takes up no room, and may be tied round an incandescent electric lamp like a bag, and held with an elastic band, thus providing a safe light for plate changing. Two thicknesses of it, shut into the porthole, will turn a cabin into a temporary dark room in the same way. For ordinary dark-room illumination, however, neither paper nor fabrics are altogether suitable, as they stop a good deal of the safe light as well as of the unsafe. They distribute the light over the dark room in a more pleasant manner, however; as is done also by ground glass.

Two kinds of light are ample for most purposes: a yellow for bromide and lantern-slide work, which would also be suitable for wet collodion, were it ever to be used, which is not likely; and a red for plates, which by being screened or by having the light turned down, may be made safe enough if orthochromatic plates are used occasionally. If they are constantly employed, the light should be a deeper red than otherwise. Brown and green have at times been suggested for the dark room, but they have never become popular, and to-day are scarcely used at all. Certainly they are not to be recommended, except for panchromatic plates.

When arranging for the lighting of a dark room, the light itself before screening should be as strong as possible. Many fail to recognize the difference between a strong light properly screened, and a feeble light with a weaker screen. Of course any light may be used if it is weak enough, and the author has changed the most sensitive plates, without the slightest trace of fog, in rooms in which there was light enough to see

everything distinctly after a minute or two. But this is not what is wanted. The larger the area of light screen and the more powerful the light, the better. In this way we can increase the visible light almost indefinitely, without making it unsafe for ordinary plates. No one who has ever worked in a properly lit dark room would ever consent to go back to the gloomy shades of the poor little oil lamp in an ill-ventilated lantern, screened by a few square inches of unsuitable ruby glass.

It is only necessary to add, that no one should use a light for more than the most temporary purposes without testing it. This is easily done by putting a plate in a dark slide, placing this where the plate is likely to be exposed to the light of the dark room, and leaving it there, with the shutter drawn half way out, for as long a time as it is likely the plate will ever be exposed to the dark-room illumination. The plate is then to be developed in the usual manner, fixed, washed, and dried. If on placing it down on a sheet of white paper there is a distinct difference between the exposed and the unexposed half, the light is not safe, and it must either be used at a greater distance or the light filter must be changed. The commonest defect of all, in everyday work, is a fogged negative. The commonest cause is unsafe light in the dark room, or undue exposure to it. Yet the simple experiment of testing the dark-room light is performed—how often?

After the light and the ventilation, the most important features of the dark room are the sink and water supply. Although some of the chemicals used in photography attack lead, a lead-lined sink, when everything is taken into consideration, is the best. Earthenware sinks are most costly, especially in big sizes, are heavy, and mean that every glass or porcelain article allowed to fall in the sink is to a certainty smashed. With lead this very seldom happens. And the most careful will knock over a bottle or measure now and then. The bench beside the sink, if the latter is lead lined, may be lead covered too, and provided with a fillet on its outer edge over which the lead is carried, while at the back the lead is turned up the wall for 3 or 4 inches. The bench is then easily cleaned down with a squeegee, a thing that should be done every time it is used.

PATIENCE

BY HUGH CECIL

The water tap is best fitted with a "splash preventer," by means of which it will give a smooth stream. It should be 15 inches above the bottom of the sink, so that the largest bottles can be filled at it, but it need not be higher than this. There are swing arm taps fitted with a rose and a bottle-filling jet, but the ordinary tap with a splash preventer answers every purpose. Two taps are better than one, and best about 8 inches apart. A negative can be placed under one of them to wash, while the other can be used in the ordinary work. A piece of clean linen or muslin about 3 inches wide and a foot or two in length, if wound round the nozzle of the tap so as to prolong it for a couple of inches, and fastened in place with a rubber band, forms a simple splash preventer, and turns the most violent rush into a gentle stream. In places where there is a system of heating by means of hot-water pipes, particular care must be used to see that the dark-room water-supply pipe is not brought alongside a pipe carrying hot water, or unexpected troubles may arise. Such a state of things is by no means uncommon, and has often been the cause of frilling and blistering of plates and papers, that seemed most mysterious until the reason for it was detected.

A few shelves for bottles, or better still a cupboard, a rack for dishes, a rail for dusters and towels, and a draining rack for negatives complete the list of indispensable dark-room fittings. Most plate-draining racks have too many grooves ; they should be at least 1½ inches apart, or the plates will take a long time to dry, and disfiguring drying marks may be expected. Where one size of plate only is used, the hypo bath may be a grooved porcelain tank, as this takes up little room and the plates fix very quickly in a vertical position. The best dishes are undoubtedly granitine or porcelain ; because the material of which they are made makes them easy to clean, and their colour makes dirt conspicuous. In course of time, however, and very quickly if solutions are left about for any time in them, the inside of the dishes becomes covered with little cracks. These cracks pass through the glaze, and allow the porous material beyond to absorb the solutions placed in the dish, and it is no longer possible to clean such dishes perfectly. They may then, if cleaned as well as possible, be used for

developing, for fixing and for washing plates, but should not be used for toning with gold and platinum, or for any operation about which the photographer does not feel that slight contamination does not matter. Xylonite dishes are the most portable and light, but they are easily broken, cannot be used for any solutions that are not quite cold, nor for solutions containing alcohol or acetone, and it is not easy to see any dirt they may contain. Papier-mache is quite unbreakable, and for developing, fixing, etc., is very suitable; but it, too, does not show up dirt. A papier-mache dish answers well for hypo, and when it begins to look worn and dirty, may have a good scrubbing with hot water and soap, be well rinsed, dried thoroughly, and painted inside and out with Brunswick Black, when it is as good as ever again. Large dishes are heavy, fragile, and expensive, if made of porcelain. They are never perfectly flat; the plate therefore rocks on them, and they take more solution than should be necessary. For this reason for sizes larger than 15 by 12 inches, dishes made of a sheet of glass in a wooden frame are popular. The bottom of such dishes is absolutely flat, as the photographer finds out when he tries to pick up a large plate from such a dish, and ultimately has to take his knife to it. These dishes are fragile, but are comparatively cheap. Best of all for large sizes, is a dish constructed of thin wood, with stouter wood for its sides, well waxed within and without, and then lined with thin American cloth. The waxing may be done with a paraffin candle and a flat iron, the dishes being made by the local carpenter. A sheet of American cloth decidedly larger than the dish is then placed in it, neatly folded, and the edges outside tacked to the wood. By ironing the cloth into position, the wax is melted and cements it tightly into place, but not so tightly that when the inside gets dirty or worn, it is impossible to strip off the cloth and reline the dish. For occasional enlargements and similar work these dishes are excellent. They are light and cheap, while if they are not easily cleaned, their lining may be renewed from time to time without much expense or trouble. After use they should always be dried and hung up.

Measures are a necessity in the dark room. The larger ones are best of cylindrical shape; these have not got that

point at the bottom which is so difficult to clean. On the other hand, they can only be used for measuring quantities which nearly fill them, and for the smaller measurements they give only the roughest approximation. One of the small measures should therefore be of conical shape so that 10 or 20 minims can be got with reasonable accuracy. A jug holding a pint and another of two pints will be found useful. A funnel or two, of glass, must be at hand; and if sulphide solutions are to be mixed up, for toning purposes, a thin glass "boiling" flask will be required. The scales should weigh from 10 grains to 2 ozs., and should not be kept in the dark room unless in a cupboard or drawer, where they are not likely to be exposed to fumes. A packet or two of cut filter paper circles may be kept with the scales, a paper being put in each pan when weighing to secure cleanliness and accuracy.

It is a very bad plan to keep sensitive plates and papers in the dark room, as there must be no room in the house where they are so likely to be exposed to fumes that may injure them. The best place is in a drawer or cupboard, under lock and key, of course, in a passage or room that is not often used. Heat, gas and other fumes, and damp are as injurious to sensitive products as light itself. At the same time a light-tight drawer in the dark room is very convenient, as plates may be slipped into it, if daylight is to be let in for a little time. When enlarging also, it will hold the supply of bromide paper, if this has been sold in an envelope which fits it so tightly that putting back the paper after taking out a sheet is almost out of the question—not, by the way, an imaginary case. A most ingenious light-tight drawer is in the dark room of a friend of the author. It is constructed on the principle of the little boxes in which French wax matches are supplied. An inner lid fits on a ledge all round the top of the drawer. The back half of this lid is a fixture, but the front half is hinged to the back and is pushed up into a vertical position by a spring. On opening the drawer the lid flies up, on closing it, the lid is pushed down, thus making the drawer absolutely light-tight, which an ordinary drawer would not be.

No dark room is complete without a nail brush, soap, and a towel. Cleanliness, personal and instrumental, is an absolute

necessity in successful photography. As a final example of the way in which dirt lies in wait for the photographer, a case may be mentioned of a succession of spoiled prints which were traced to the accidental dipping first into one solution and then into another of the photographer's coat sleeve. Shirt-sleeves and an apron form the best dark-room uniform.

CHAPTER X

EXPOSURE

Gradation the test of exposure—Hurter and Driffield's "perfect negative"—The latitude in plates—Over-exposure at first only causes fog—The factors which influence exposure—Strength of light—The influence of the lens—The speed of plates—The Hurter and Driffield, Watkins and Wynne numbers—Their translation—The subject—Exposures indoors—Meters and tables—The Actinograph—The Watkins meter—The secret of success with the Watkins meter—Exposures in sunny climes—A little haze no drawback.

EXPOSURE is the crux of the photographic process. Beside it the other operations are comparatively simple, and can be definitely and fully prescribed. But the exposure of the plate must be governed by circumstances, which, in most cases, cannot be foretold, and some, even at the time, can only be estimated. In the early days of the dry plate, it was generally accepted that if the photographer exposed his plate incorrectly he could remedy it in development. In other words, it was said that he could "compensate for under or over exposure." That has long since been shown to be a fallacy; and although careful quantitative experiments indicate the possibility of errors in exposure being to some extent remedied by development modifications, such modifications are not those which photographers employ, nor indeed are they of real service in actual practice. The mistake lay in supposing that methods which make an over-exposed negative look—superficially—like one that has been correctly exposed, remedy the over-exposure. A negative is only a means to an end; that end is the print. If the remedy for over-exposure does not give a print that differs in any way from one obtained from a negative "unremedied," the remedy may fairly be considered as inoperative.

The beauty of photography is its power of rendering half-tone or gradation. Two photographs of the same subject may

differ very widely in this respect. They may both have the highest light equally white, and the deepest shadow in each may be an equally dark tone, yet everything else may be different. In one a tone in the original which lay about midway between those two extremes, may in the photograph be equally midway between the brightest and the darkest tones; in the other the intermediate tone may be altered so as to be almost as dark as the darkest, or as light as the lightest. The result is that the latter print seems altogether wrong, though to the unpractised eye it is difficult, if not quite impossible, to say just how it is wrong. This defect is quite apart from the value of the gradations themselves; it is not flatness nor harshness, which are qualities dependent upon the *actual* value of the gradations. It depends solely on their *relative* values. Whatever result the photographer may want to get in the end, he always aims—though sometimes very blindly—to get the relative gradations right in the negative. The actual conditions under which this is possible were first clearly laid down by Dr. Hurter, an eminent chemist, and Mr. V. C. Driffield, an engineer, who collaborated with him, in the most important photographic research of modern times.

This is not the place for a discussion of the experiments of Hurter and Driffield, or even for a recapitulation of the whole of their results. But the outcome to practical photographers may be summarized briefly, and is easily understood. A "perfect negative" they considered to be one which reproduced truthfully, but in negative form, all the tones of the subject—not one in which the intermediate tones were shifted nearer in value to the highest or the lowest tone. The degree of contrast in such a negative was governed by the printing process which was to be used with it—some processes require a "stronger" negative than others, as is well known; but, whatever the contrast, the intermediate tones must all be in their proper proportions if the negative is to be considered perfect. Such a negative can only be obtained when the plate has been correctly exposed. If it is then developed with a developer which does not fog the plate in the comparatively short time during which it is exposed to it, which developer is practically free from bromide, the result will be a perfect negative. If it is developed for a very short time, the negative will be a thin one, suitable for bromide enlarging

and other purposes for which much contrast is unnecessary. If it is developed longer, the negative gradually acquires more and more contrast, but it is still a "perfect negative," the relation between its different gradations being unaltered, although the extent of the difference keeps on increasing with development. This result is expressed by saying the density ratios are unaltered by development. A point is reached at length, beyond which development is unnecessary, the negative acquiring too much contrast for any printing process. If, therefore, we have a correctly exposed plate, and we apply to it a suitable developer, we can get a negative suitable for any printing process we like, according to the extent to which we allow the plate to develop.

The "perfect negative" of Hurter and Driffield is the type of negative every photographer tries to get. It is a negative which can only be obtained by exposing the plate correctly.

This would indeed have been sad news to photographers if it meant that they had to time their exposures to a nicety; but, fortunately, it is not as it looks at first. The same researches showed that most plates possessed a good deal of "latitude in exposure," some had an immense amount, and all had some. The meaning of the expression can be shown by an example. If it is found that a plate will give a "perfect negative" with a certain exposure, it will give an equally perfect negative with twice, four times, eight times, occasionally even thirty-two times as long. This latitude depends on the subject, the character of the emulsion on the plate, and the thickness of its coating. The thicker the plate is coated, within reason, the greater the latitude. The slower the plate, as a rule, the greater the latitude also; though to this there are exceptions. The shorter the scale of light and shade in the subject, the greater the latitude also. So that we no longer have to hit upon the exact exposure, which would under most conditions be almost if not quite impossible, but have a margin, within which any exposure will be correct.

Every photographer knows that if he takes two plates, and gives one eight times the exposure of the other, he gets two widely differing negatives; yet few would be able to state definitely in what manner the two negatives differ. If both were of the same subject, and both were correctly exposed, one,

let us say, having eight times the exposure of the other ; and if the two were developed side by side in the same dish for the same time, different as they would look to the eye, the prints which they would give would be identical. All that would be required would be to print one for a longer time than the other. The negative which had the longer exposure would be the exact counterpart of the other, except for a certain amount of fog. That fog is measurable. With proper appliances, it is quite easy to fog an unexposed plate, develop it to the required point, and then by putting it in contact with the negative which had the shorter exposure, to make it appear, and be, exactly identical in every respect with the negative which had the longer exposure. The fog would make the negative take longer to print, but would not otherwise have any effect upon it that we need consider in this place.

As time of printing is comparatively unimportant beside truthfulness of tone, it would appear that so long as the exposure is a correct one, it does not matter much whether it is a large correct or a small correct one. In many subjects it does matter, however, as has been shown in a previous chapter, when dealing with the subject of halation. The shortest possible correct exposure is that which gives the least risk of halation.

The importance of correct exposure, within the limits of the latitude of the plate, having thus been shown, it remains to consider the methods by which it can be obtained. Exposure is influenced by—

1. The strength of the light.
2. The focus and aperture of the lens.
3. The speed of the plate.
4. The nature of the subject.
5. The movement of the subject or of the camera.

This last factor is not limited to hand-camera work, but still is so largely a hand-camera consideration that we may pass it by for the present. The others make fearsome list enough by themselves. It was customary for photographers at one time to look at the brightness of the image on the ground glass, and to conclude from that the exposure required. It was a rule-of-thumb method, and resulted in many failures, until in time a kind of knack of guessing exposures was acquired. One

LANDSCAPE]

BY CHARLES JOB

thing is quite certain, and that is that, consciously or unconsciously, the photographer was not influenced by what he saw on the ground glass. Such workers are still amongst us, and from their long experience are still some of the cleverest photographers, but a new generation is rapidly arising to which such "methods" are unknown. Photographers cannot now afford the time or the material to acquire the knack of judging exposure nearly half as well as it can be done mechanically, and amongst all but the hopelessly antiquated, the exposure meter reigns supreme.

The strength of the light at the time of making the exposure is influenced by three distinct things—the height of the sun, the state of the atmosphere (which means more than is usually understood by the weather), and the physical obstructions by which some of the total light is cut off from the subject photographed. Abney, Eder, La Baume Pluvinel, and others, compiled tables showing the fluctuation in daylight throughout the year, and at different times of the day. The best known of all was that of Dr. J. A. Scott. Other tables were drawn up to show the variation due to the weather, while yet a third table dealt with the different classes of subject, and the lens. By extracting from these tables the figures standing for the particular conditions of the moment, and multiplying them together, a figure was arrived at which was the exposure required by a particular speed of plate. Until towards the end of the eighties this was the only method of calculating the exposure that was available. It gave by no means an invariably correct result, and was used by comparatively few. Even guesswork, to most, seemed preferable.

At about that date the conclusion was reached of a long series of careful measurements, conducted during several years, by Messrs. Hurter and Driffield. These showed that the influence of the height of the sun was a perfectly definite one, and enabled them to tabulate and to express in the form of curves the changes in the power of daylight due to this cause. These curves formed the basis of the "Actinograph," by which exposures could be estimated. The influence of the weather upon the strength of the daylight is not so great as might be imagined. The older tables gave it as one to five—that is to say, place, season, and time of day being the same, the light when

the weather is very bright is not more than five times as strong as when it is very dull. Hurter and Driffield made it even less—one to four.

Besides the height of the sun, and the weather, there is an important modification of the daylight effected by the dust-laden atmosphere through which it passes. This is best seen at sunset, when the thickness of the atmosphere through which the sun is seen is greatest. The red colour of the light is then most pronounced, and red being the tint to which photographic plates are least sensitive, the light at such times is not as strong, photographically, as it seems.

The influence of the lens upon the exposure is easily expressed. It may be said to be governed entirely by the ratio which the diameter of the opening in the stop bears to the focal length, which photographers speak of as the F/ number. So long as the other conditions remain the same, all lenses working at the same F/ number require the same exposure. While this is quite accurate enough for all ordinary purposes, it is not absolutely true. The glass of which a lens is composed absorbs a certain quantity of the light entering it, and the thicker the glass, the more light it absorbs. If the glass has any trace of a yellow tinge, it is absorbing just that light which is most active on the plate. Some old lenses have this tinge of yellow, due to the action of light upon the particular glass of which they are made. Such lenses act to some extent as colour screens, and wonderful properties have been claimed for individual specimens from time to time. Needless to say, if a colour screen is to be used, it is better to have one made suited to the plate with which it is to be employed, than trust to the haphazard of a yellowed lens. Occasionally the balsam with which the different glasses of the lens are cemented together turns yellow and cuts off useful light.

Both these defects are very rare, and need not be taken into consideration at all as influencing exposure ; but there is another circumstance whose power in that direction is often overlooked. A lens with a focus of 8 inches and a stop 1 inch in diameter has that stop marked F/8. This is only its true designation, however, so long as the focussing screen is 8 inches from the lens—that is to say, at its principal focus. To take an extreme case, suppose copying the same size as the original is

in hand. The stop is 1 inch in diameter, but to get the copy the right size and sharp, it will be found that the screen has to be 16 inches from the lens instead of 8, so that the stop marked F/8 is actually F/16, and the exposure must be altered accordingly. Under ordinary circumstances, the focussing screen is not moved so far from the principal focus as to necessitate any allowance on this account, but in portrait work and in copying it may be.

Another source of error that is sometimes overlooked is the use of one combination of a double lens only; this has been dealt with in Chapter VII.

The speed of the plate is the third factor to be considered in exposure calculations. Any one whose knowledge of plate speeds is derived from the marks on plate boxes will have a very erroneous idea as to their definite character. A case in point will make this clear. A good many years ago, the author was secretary to a committee appointed by the Royal Photographic Society to investigate the whole question of plate speeds in the hope that some definite system might be adopted. It fell to him to obtain a number of different plates, and to give two of each kind to each member of the committee, that he might work out their speed in his own method, not knowing what were the plates with which he was dealing. When the committee met and the results were compared, it was found that the experts who composed it were not even in agreement in the order in which they arranged the plates in point of speed, much less did they agree upon the figures denoting the speeds. Moreover, it was not found possible to agree even upon a definition of "the speed of a plate." The only method of ascertaining speed at one time was by means of a highly ingenious instrument called the Warnerke sensitometer, which had only one defect, and that was that its results were quite erroneous when tested in the light of actual practice. It compared plates according to the quantity of light action required to produce, on development, the faintest perceptible image on the plate. As such an image was quite unprintable, the reading given by the Warnerke sensitometer would only be correct if the exposure required to produce a printable image bore some definite relation to that which was sufficient to produce one barely visible on the negative. It does not. It was soon found

that of two plates, one might prove to be faster than the other in the sensitometer, while in actual negative making in the camera the positions were reversed. An attempt was made to get over this by reading, not the faintest visible image, but the feeblest printable image; but this varied according to the judgment of the reader, and even then did not agree with the behaviour of the plates in practice.

It was Hurter and Driffield, in the memorable research to which reference has already been made, who first showed that it was necessary to take into consideration the exposure required to give, upon development, that rendering of the subject which they called a "perfect negative." There is no need to go into the methods by which this is done, as it is a matter for the plate maker rather than for the plate user; but they worked out a complete system of plate testing, by means of which it is possible to express the speed of a plate as a number inversely proportional to the exposure that plate requires to give a "perfect negative" under definite conditions. This is now known by their initials, and plates are marked H. and D. 50, H. and D. 100, and so on, the latter requiring one-half the exposure of the former. A good many makers now mark their plates with the H. and D. numbers, but owing to differences in the manner of making the tests, the H. and D. numbers of one maker do not compare strictly with those of another, though they are reliable enough for the plates of different speeds by the same maker. Marion and Co., so far as the author is aware, are the only makers whose H. and D. numbers are obtained strictly on the lines laid down by Hurter and Driffield. The H. and D. Actinograph has already been mentioned.

Watkins and Wynne make exposure meters, in which it is necessary to denote plate speeds by means of a number, and each of these makers issues lists of plates giving the Watkins or the Wynne number for each, these numbers being obtained by actual tests of the plates, and checked from time to time. The use of them will be referred to later on. The following rules for converting H. and D. numbers into Watkins and Wynne numbers are given by Mr. Sterry :—

To obtain the Watkins number, multiply the H. and D. number by two; and *vice versâ*, to obtain the H. and D. number, halve the Watkins number.

GRANNIE'S TIRED BAIRN

BY JOHN HEPBURN

To obtain the Wynne number, multiply the H. and D. number by sixty-four and take the square root; and *vice versâ*, to obtain the H. and D. number, square the Wynne number and divide by sixty-four.

As the H. and D. numbers on plate boxes are not strictly comparable, it is much better, whenever practicable, to obtain the lists of plates and speed numbers issued by Watkins or by Wynne, and to use those.

The nature of the subject is the only remaining factor to consider for the moment; and, thanks to exposure meters, it is now the only factor which the photographer must furnish from his own judgment. If we can measure the light that falls on the subject, we need only consider its colour and distance. Dark-coloured objects, and those which are yellow or red, may require as much as twice the average exposure. Very light objects, on the other hand, may be fully exposed with one-half. If all the other conditions were unaltered, three photographers facing a whitewashed building, an ordinary grey stone building, and a blackened ivy-covered ruin respectively, would be within the mark if they gave exposures one-half and twice that given for the stone building. Those who have never used an exposure meter are surprised at the very little difference which the subject itself demands, but this is undoubtedly due to the fact that they have not been accustomed to consider separately the influence of each factor.

The distance of the most important part of the subject has far more influence. The nearer an object to the camera, the longer exposure will it require. The cause of this is that we see everything through a veil of air laden with dust and with moisture which reflects the light, and so makes the apparent darkness of any object get less and less as the thickness of the layer of air through which we view it increases. Authorities are agreed that the ratio of 1 : 10 represents the effect of distance upon exposure. That is to say, an object at the greatest distance at which it is likely to be photographed will require about one-tenth the exposure the same object would require close at hand. Thus the grey stone building just alluded to, which would be presumably within fifty or a hundred yards of the camera, would require about ten times the exposure that it would need were it on the horizon. The

only views often photographed at such distances are panoramas of sea and sky, and we are therefore safe in giving them about one-tenth that which would be given to buildings or landscapes of the ordinary character. On the other hand, objects which are much nearer to the camera than fifty yards are not affected to any noticeable extent by the intervening atmosphere, and the exposure need not be altered in consequence.

The exposures hitherto considered have been exclusively out-of-doors. But the conditions indoors are not greatly different, provided always we can measure the actual light falling upon the subject. The question of distance ceases to be troublesome. In the case of portraiture in a studio, exposures hardly present any difficulty at all; the conditions vary so little that the photographer soon acquires the knack of estimating them without using any meter or other appliance. There is another consideration here, which helps to make it easier. The scale of gradation in a portrait is usually very short. The highest light may be a collar or cuff, rarely, if ever, in sunshine; the deepest shadow the fold of a dark dress, illuminated by reflected light from the studio walls, and possibly from reflectors employed for the special purpose. In outdoor work we may have a whitewashed wall on which the sun shines, and a dark oak door in deep shadow. The range in the latter case may be four times as long as in the former, or even more. This means that if we have a plate which gives us a latitude in the case of the landscape of four times, it will give us a latitude of sixteen times with the portrait. As a matter of fact, many of the plates on the market will far exceed this.

A consideration of all these factors may make the problem of correct exposure seem almost insoluble, but this is very far from being the case. In fact, if it is approached the proper way, and a little trouble is taken to understand it at the outset, it becomes quite simple. There are a number of appliances by which exposures can be ascertained. These fall into two groups, exposure tables and exposure meters. The former give assistance in calculating approximately the power of the light, the latter directly measure it. This last would be perfect if the sensitive preparation by which it was measured was affected by light in exactly the same way as the plate; but

theoretical perfection in this respect has not been reached. But in practice, except under special and infrequent conditions, when orthochromatic plates are used, the light measurers give indications upon which the photographer may implicitly rely. In his own work the author uses an exposure meter invariably.

There are various representatives of these two types of exposure aids, but a typical one of each need alone be mentioned. Amongst exposure tables, the "Actinograph" is at once the most perfect and the most widely applicable. It is a combination of the curves of light intensity, ascertained by Hurter and Driffield, with a slide rule, and its general appearance can be seen from the illustration. The card at the top is pulled out until the top scale cuts it at the date on which the exposure is being made. This scale is then slid along until the figure representing the lens and stop employed comes against the black line on the card bearing the time of day. The lower sliding scale is then moved until the mark on it is against the figure which, in the bottom graduation of all, stands for the H. and D. speed of the plate. We can then read off the exposure in seconds, according to the weather, "very dull, dull, mean, bright, or very bright," the last being one-fourth the first. The whole calculation need not take twenty seconds. The result is the exposure for an "ordinary landscape," which is not quite the same kind of object as what Watkins calls his standard subject, but is more of an open view. (The Watkins standard subject requires about one and a half times the exposure of the Actinograph "Ordinary landscape.") The number read off on the Actinograph is multiplied by two or three for close subjects or for subjects which have heavy shadows in the foreground; is halved, or even further diminished for

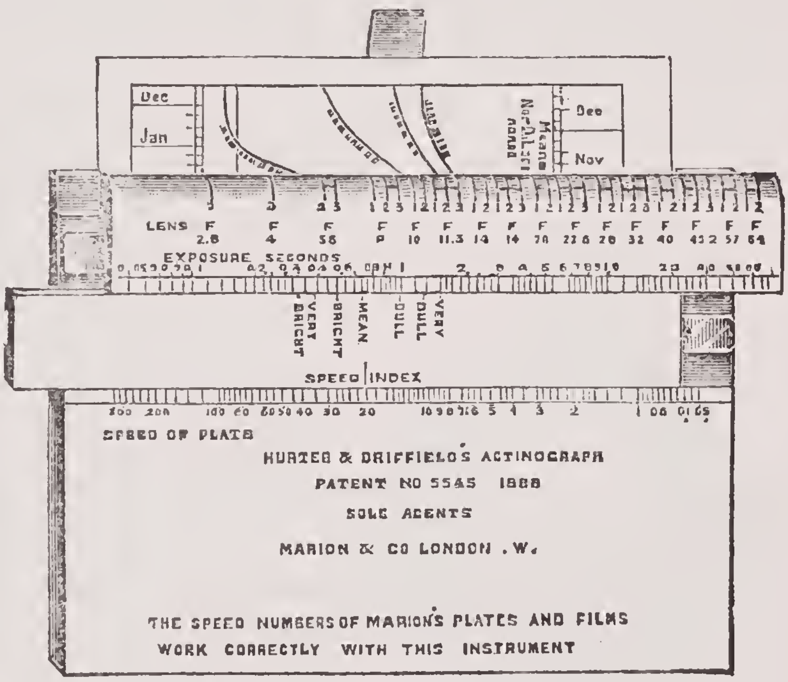

Fig. 13.—The Actinograph.

distant views. But it only has to be modified to suit the character of the subject, all the other factors having been taken into consideration by the little machine itself, and in this way the problem of correct exposure is very greatly simplified. The "Actinograph" has one drawback, which unfits it altogether for the globe-trotting photographer. As its light scales depend upon the height of the sun above the horizon, it is only applicable to exposures in the latitude for which they are arranged, and if the photographer travels much to the north or south thereof, he must either abandon the instrument or provide himself with light curves for other latitudes. The makers supply several of these; but the need for them must be recognized as a factor in the want of popularity from which the Actinograph has suffered.

No such limitation affects the Watkins exposure meter, which we may take as a type of those instruments which measure the light at the moment of exposure. This most useful tool is made in a variety of patterns, some of which are extremely simple and are low priced.

FIG. 14.—WATKINS "BEE" EXPOSURE METER.

The pattern that is most generally used is that known as the "Bee" meter and shown in Fig. 14. It is very simple in use. Watkins from time to time publishes lists of plates against which are given the speed numbers according to Watkins' system. Having ascertained the speed of the plates that are in use, and the time taken for the sensitive paper to darken to the standard tint which is sold with it, the meter is held by the ring at the top, and then holding the glass and back between finger and thumb, we find we can rotate these together. We do so, until the figures on the inner dial marked "stop," which correspond to the stop which is being used, come against the number on the rim, marked "Plate." which represents the speed of the plate as given by Watkins. On the other side of the face of the meter on the dial we then find in the column marked "Light" the number of seconds which the meter paper took to darken, and then against this on the rim, in the column marked "Exp," is the exposure. The calculation with this form of meter

does not take half as long to perform as this paragraph takes to read.

Alterations on account of subject are not extensive. The exposure ascertained as just described is commonly correct. But it may be modified in four different degrees, at times, as given by Watkins in the following list :—

Sky, or sky and sea	S. 10, or $\frac{1}{10}$ the indicated exposure.
Snow and glacier scenes; white, or black and white prints or objects; sea view with shipping	S. 25, or $\frac{1}{4}$ the indicated exposure.
Light coloured objects; open landscape (no foreground), lake or water scenes; half-tone photographs	S. 50, or $\frac{1}{2}$ the indicated exposure.
Very deep coloured objects, as old oak, old paintings	S. 150, or $1\frac{1}{2}$ the indicated exposure.

The indicated exposure referred to is that marked E, or that for the standard subject.

The whole secret of using the Watkins meter successfully lies in the testing of the light by its means. The meter is not held in sunlight, or even in diffused light by the camera, but the light to be measured must be that which falls upon the shadiest part of the subject in which full detail is required. The instrument is so held that it faces the sky under these conditions. To do this it does not mean that of necessity the meter must be carried to the shadiest part of the subject, and there exposed ; in most cases it is possible to extemporize a shadow to correspond. If the body is turned to face the same way as the shadow side of a house in a street scene, and the meter is held near the body and in its shadow, the reading will usually be near enough. If the view is an open landscape with no very deep shadows at all, the meter may be held further away from the body. A little familiarity with the instrument, if the results obtained with it are noted, will make its use quite simple and its indications almost if not quite infallible. In outdoor work, if the light is fairly constant, there will be no need to measure it for every exposure, as will soon be seen. With hand cameras, where there are only one or two speeds at which the shutter can be set, the meter can be used backwards, setting the exposure scale to one of the exposures

possible with the shutter, and finding out from the scale marked D the stop which with that exposure will be correct.

There is a belief about that success in photography depends upon a powerful light, and that countries with uninterrupted sunshine and cloudless skies are particularly favourable to the camera user. Like a good many more of the popular ideas on photography, it is a complete fallacy. Hand-camera work, where plenty of light is a necessity, can be carried on in sunny climes more days in the year and more hours in the day than it can in England. But that is the sum-total of the advantage. On a sunny spring or summer day in Britain, exposures will be found to be every bit as short as those in countries much further south, where the sun beats down from a cloudless sky. The reason is easy to understand. Exposures must be made for the shadows and not for those parts on which the sun falls directly, and the moisture-laden atmosphere of Britain causes the shadow to be lighter than the clear dry air of, say, a Spanish summer. Except in countries like Switzerland, where snow-covered mountains act as vast reflectors, sending light into shadows never reached by the sun itself, it will not ever be found that exposures are very much shorter than they need be in good summer light in this country; while it need hardly be pointed out that, pictorially, the clear atmosphere presents a very real difficulty to the photographer instead of aiding him.

A few years ago, during the great coal strike in America, the author visited New York, and took some photographs as mementos of his visit. Several of the Americans he met assured him that owing to the smoke-laden atmosphere due to the soft coal they were then compelled to burn—it was about as smoke laden as Cumberland—they would give quite an unfavourable view of their city. On the other hand, it was infinitely more beautiful than it appeared a few weeks later, when the strike was over, the hard smokeless coal once more in use, and the distant New Jersey shore as clear cut and as near as the buildings in the next block. The atmosphere of London, whatever may be said of its hygienic properties, lends a charm to many of its prospects, which an artist cannot fail to appreciate.

A STREET IN COUTANCES

BY HERBERT BAIRSTOW

CHAPTER XI

DEVELOPMENT

The latent image, theory and practice—The speed of plates considered a matter of development—Control in development—The Kodak developing machine—The appearance of the picture—The problem, how far to develop—Solved by inspection—By the Watkins method—By time—Developers—Removing the backing—Fixing—Acid hypo baths—Washing—Hypo eliminators—The ideal washer—Varnishing.

IF it were necessary to show how completely in photography practice has outrun theory, nothing more is required than to give the case of the latent image. We take a sensitive plate, and expose it in the camera. We know the result of that exposure is to bring about such a change in the film that on applying a suitable agent the silver bromide where the light has acted is reduced to metallic silver, while where the light has not acted reduction does not take place, at any rate so soon. Yet though the result is known, the nature of the change in the plate brought about by the action of light remains a complete mystery. There are two conflicting theories, and each has its supporters.

While our knowledge of the theory of the latent image is so imperfect, a great deal of light has been shed upon the practice of exposure and development, and here again we at once encounter the names of Hurter and Driffield. We have already seen that until the publication of their great paper before the Society of Chemical Industry in 1891, it was universally believed by photographers that they possessed the power of compensating for errors in exposure by modifications in development. So long as such a belief held sway it was manifestly impossible to express in any definite manner the "speed" of a plate, since it followed that this was entirely a question of developer. If a photographer could turn an under exposure into a correct exposure by a change in the developer, he made the plate

faster by so doing, and *vice versâ*. The source of this error, for such it is now known to be, lay in the failure to recognize *gradation* as the true index of exposure.

While most plate makers, being pecuniarily interested, were quick to avail themselves of the work of Hurter and Driffield, plate users, trained in the earlier methods, were by no means so ready to apply that work to their own practice ; and even to-day there are plenty of photographers who develop in the old way, adding alkali if they think a plate is under exposed, and bromide if the fault seems to be in the other direction, under the impression that they are compensating for such errors. Gradually, however, the truth is working its way amongst even the old style photographers, that the development of a plate should be almost as definite an operation as fixing itself, consisting of the application of the most powerful unrestrained developer the plate will stand, until it has done the required work in the film. This leaves one factor alone for control by the photographer, namely, the extent to which development should be carried.

Control of the extent of development can be exercised by controlling the proportions of the different ingredients of the developer, the temperature at which development is carried out, and the time during which the developer is allowed to act. Generally speaking, it is well not to change the first, unless the make of plate itself is changed, but to ascertain the composition of the developer which will do all that is required before it apparently acts upon the unexposed parts of the plate, and to use such a developer always. Control of the temperature is actually very simple, although few photographers care to regulate it directly by standardizing the temperature of their solutions by means of a thermometer. The most usual method of development is to ascertain the time taken for the first sign of the image to appear, and to develop for some multiple of that time. But it is quite easy, by making up a standard developer, ascertaining the temperature of the liquid and then developing the plate for the time required by that temperature, to produce uniform and excellent results.

This is the principle upon which the Kodak Developing Machine and the Kodak Tank Developer were based, and the success with which those machines operated, astounding as it

often was to the photographer filled with the belief in his power of control, played and is playing a large part in the rapid adoption of the same principle to the development of plates.

Having settled upon the composition of his developer, there are three methods open to the photographer, which we will consider in order. In the first, he applies the developer to the plate, rocking the dish the while, and watching the appearance of the image by the red light of the dark room ; the second is the Watkins factorial method ; and the third, time development pure and simple.

There is no more wonderful or attractive experiment in the whole range of physical science than the gradual building up of that picture in metallic silver, on the slight and mysterious foundations laid, it may be in the thousandth of a second, by the impulse of light alone. It is an experiment which, to the reflective mind, can never lose its interest. There is the creamy coating on the plate without a sign to suggest in the faintest manner the wonderful potentialities that lie upon its surface. No test that we can apply, other than the developer itself, will even tell us whether it is in its pristine state of purity, or whether it has already had the magic touch which has given it the power to preserve through all time a minute and impeccable record of a state of things itself perhaps of the most transient character. We thoughtlessly snap off our camera at an express train as it dashes through a station. A hundred years afterwards, if the negative is preserved, it will not merely give us the impression of the train in its passage, it will show us the people on the platform, the signals with their message of safety or danger, the arrangement of the very bricks in the station walls. Nay, it will tell us the particular stalks of the particular plants in the porter's garden that at that moment bore flowers. What other everyday action can compare with this, either in the elaborate detail of the result, or in the simplicity of the means by which it has been brought about? And this is the miracle which takes place in the dark room of every photographer each time he develops a plate. How often do we spare a thought from the trivial anxieties of the moment to the marvellous character of the powers we are employing?

This change then is watched by the photographer, with his

mind as a rule, it is only reasonable to suppose, directed upon the immediate problem which confronts him. That problem is, how far to carry development. He watches the gradual emergence of the image on the film, notes how it darkens over in the most exposed portions first, until the details there are no longer perceptible, and how this darkening gradually extends to the shadows also. If all is as it should be, the edges of the plate where the light has not acted at all, whatever happens, should not perceptibly change colour ; but if the exposure has been the shortest correct one, there will be a distinct darkening in even the deepest shadows. If these remain white, the plate is unquestionably under-exposed. But, assuming that it has been properly exposed, they will in time dull over ; until, looking at the plate as it lies in the dish, the darkest parts of the subject can only just be seen as distinctly lighter in tone than the rest of the plate. The photographer then knows that development is nearing completion. If stopped at this stage, the negative may be a "perfect" one, in the Hurter and Driffield sense, but not necessarily so for the purpose for which it is required.

Some of the printing processes in use require a soft negative, some a medium, some a distinctly hard negative. The difference is solely brought about by the extent to which development is carried, and the photographer has now to decide how far he is to continue the operation. To do this by the eye he has three guides: the appearance of the plate looking down on its surface ; the appearance on the back ; and the appearance looking through it at the light. The first we have alluded to, and theoretically this should be the most reliable, because it is not influenced, as are the other two, by the thickness of the coating on the plate. Actually all three are observed ; modern plates are all machine made, and there is comparatively little variation in the coating. Looking through the plate at the light, the image should look decidedly stronger than is desired in the fixed negative, though how much stronger it is hard to judge. If the plate is a very thickly coated one, and the exposure is correct, but full, it is quite possible that little or nothing will be seen on looking through it, the film to the weak red light seeming quite opaque. The appearance at the back is then the only guide. In a landscape, the outline of the sky should be plainly seen on the glass of the plate, though

the sky ought not to appear as very greatly darker in tint than the rest, or the plate is either very thinly coated or is over-developed. Using plates of the same brand, it is not at all difficult to determine, approximately, when to stop development in this way, though no such uniformity in the resulting negatives is likely to be secured as when time development pure and simple is employed.

The Watkins factorial method of development is the easiest that a beginner can adopt; and as used with the Watkins exposure meter, it will be found to give the highest percentage of successful results. Watkins has worked out a series of factors for different developing solutions, the factor being the multiple of the time of appearance of the image, required for complete development. To use this method, then, the developer is poured on to the plate, and the time noted. As soon as the high lights are distinctly visible, the time is again noted. Multiplying the period that has elapsed by the factor for the particular developer in use, we get the time required for complete development.

The advantages of the Watkins factorial system are undeniable. The plate may be kept covered during the whole time of development, except while looking for the first appearance of the image. As soon as this has been noted, a card may be put over the dish, and the total time worked out while the plate is in darkness. There is no uncertainty as to the extent to carry the operation, and so long as the exposures are reasonably correct, as they should be if the Watkins meter is used, the method gives remarkably uniform negatives. With under- or over-exposures, it is not reliable. An under-exposed plate takes longer for the image to appear, and therefore by the Watkins method it takes longer to develop; an over-exposed plate is the reverse. The tendency, therefore, is for the under-exposed plate to be over-developed, and the over-exposed under-developed. Neither course is desirable, and tends to exaggerate the defects caused by under- or over-exposure alone. If several plates are developed at once by the Watkins plan, and the image on some appears sooner and on some later than on others, if the time of one of the correctly exposed plates is noted and used as the basis for developing all of them, the results on the over- and under-exposed plates will be better than if they had been developed for the times indicated by the appearance of their own images.

The factor for each developer is not a hard and fast figure, but, necessarily, depends upon the purpose to which the negative is to be put. Thus if we find when using Watkins' own figures, that they give negatives harder or softer than we require, we can decrease the factor in the former case or increase it in the latter, until it yields the kind of negatives wanted. The following are a few of the factors given by Watkins himself, in his book, "The Watkins Manual," which should be consulted for further details of his system.

	Grains of pyro per ounce.	Factor.
Pyro-soda (without bromide)	1	18
" " "	2	12
" " "	3	10
" " "	4	8
" " "	5	6½
Pyrocatechin		10
Hydrokinone (with the usual amount of bromide)		5
Monomet (metol)		30
Amidol (2 grains)		18
Rodinal		40

Pyro-ammonia cannot be used with this method, as the results are quite unreliable. The disadvantages of pyro-ammonia, however, should prevent its employment quite apart from this. It requires much skill in its use, and on no account should be employed by a beginner. Pyro-soda is perhaps the most universally popular, as it is most certainly the cheapest; but metol-hydrokinone has many admirers. In the case of combination developers, the factor can be obtained by taking the average of the factors for the two components in the proportions in which they are used. Thus, to arrive at the factor for a developer containing seven parts of hydrokinone to three of metol, we add together seven times the factor for hydrokinone and three times the factor for metol, and divide the result by $7 + 3$.

$$(7 \times 5) + (3 \times 30) = 35 + 90 = 125$$
$$125 \div 10 = 12\tfrac{1}{2}, \text{ the factor required.}$$

IN AN OLD CHURCH

BY HENRY W. BENNETT

Those developers which have a small factor, such as, for example, hydrokinone, have that factor very greatly modified if bromide is added to the developer; but with those which have a high factor, metol, etc., the presence of bromide has little or no effect upon it. It has already been pointed out, that in any case bromide should not be added to a developer, as its action, as far as it is traceable, is distinctly injurious. Although a few plate makers still give bromide in their formulæ, it is hardly necessary; and there is certainly no need for it with any of the plates made by the better makers, most of whom do not specify any bromide.

The third method of development is by time, pure and simple. The developer is applied to the plates for a given time dependent upon its temperature, after which they are fixed and washed. There is no need in this case for the plates to be exposed to the dark-room light at all, except to make sure that they are covered with the developer. Any light-fog should therefore be impossible. There is no temptation for the photographer to try and make all his negatives of uniform density, the besetting sin of those who judge development by the eye. Such a course leads to the under-development of over-exposed plates and the over-development of those that are under-exposed; and is responsible for the belief that over-exposure gives thinness and under-exposure excessive density; both views are quite erroneous. If an under-exposed, a correctly exposed, and an over-exposed plate are developed in the same dish for the same time, that time being what is required to make a perfect negative of the correctly exposed plate, it will be found that at the same time the best that is possible has also been made of the other two. We have not ruined the under-exposed plate past recall by over-development, as is so often the case, and if the under-exposure has not been too great it is quite possible that we may be able to intensify the negative so that it may give a passable print. In the same way, judicious reduction will do the best with the over-exposed plate.

The Kodak developing machine was the first commercial apparatus to employ this principle. It is found in the hands of those who have never developed a film in their lives to give results which are as good as the most skilled developer could

make. So certain is the evidence afforded, that the Kodak Company itself uses the machine entirely for the development of roll films, and finds that the percentage of good negatives obtained is quite as high as when the films were developed by their skilled operators in the old method. This is all the greater testimony, since the films dealt with are those of customers many of whom have little or no idea of correct exposure. In the case of this machine, there are the added advantages that it dispenses with any necessity for a dark room, minimizes the risk of finger marks and scratches on the film, and enables a long length to be developed in a compact and easy manner. Great as are these advantages, they are comparatively unimportant beside the fact that it secures uniform development, and ensures the process being carried exactly to the proper stage. The Kodak Company supply developing powders (pyro-soda) for use with the machine, and get over the difficulty of bringing the temperature of the developer up or down to a standard, by a table showing how long the development should take for the different temperatures likely to be met with. This simple method has now been extended to plates and cut films.

Time development of this kind applied to plates, means that the photographer must first find out for himself, as such particulars are at present given by few of the plate makers, the time which the developer he selects requires to turn a properly exposed plate into the kind of negative he wants. Either he must do this for the different temperatures at which he may develop, or he must always work at the same temperature. The former plan is more reliable in practice, but the latter is simpler. It is accompanied by the drawback that if the standard temperature is very different from that of the room in which development is being carried out, the developer soon alters in temperature and the result is not what was anticipated. The Watkins system, with correctly exposed plates as a guide, is actually one of time development and nothing more, the time of appearance of the image acting as a thermometer, and the factor enabling us to put its reading into practice. Taking its merits and its defects into consideration, it is at present undoubtedly the readiest method of obtaining the best possible negative on plates or cut films, as

the Kodak appliances unquestionably are when roll film has to be developed.

So far nothing has been said of the different substances used for development; but it will have been inferred already by the reader, that the nature of the developer is comparatively unimportant. Formulæ for developers are given wholesale in the instruction books, and every box of plates has with it the formulæ which the maker recommends. These are not of necessity any better than any of the others that are at the service of the photographer; but in most cases the makers' formula has this one advantage—it indicates the most vigorous developer that can be applied to the plate without fogging it. Ready-made developers, speaking generally, are a mistake. They are usually purchased by the rawest beginners, and as the ready maker has probably some experience of this class, he takes care that his developer shall contain such a proportion of bromide as shall serve to counteract as far as possible all the beginner's propensity to fog his plates. He is not to be blamed for supplying an article which gives the greatest satisfaction to the greatest number of those who buy it, but his article is to be avoided unless he can be induced to state definitely and truthfully that it is free from restrainer of any kind.

It is a great mistake to wet a negative with water before putting it in the developer, as this has a strong tendency to form air-bells, which may not be noticed in time to prevent them from leaving a mark. To avoid these, if the plate must be wetted, it should be placed under a strong flow of water from the tap for a minute or two. The force of the water acts as a guarantee against the adhesion of any air-bells; and there are circumstances in which the preliminary wetting of the plate may prove advantageous, as for example, when a large plate has to be developed with a very small quantity of solution. The quantity of liquid required to develop a plate is governed more by the nature of the dish than by the chemical requirements of the film. A dish with an irregular bottom, or one which bends in the hand, takes much more liquid than a rigid dish with a smooth bottom, little larger than the plate itself. An ounce for each quarter-plate may be taken as approximately correct.

Even in so simple an operation as the pouring on of the developer, there is plenty of room to make mistakes. The developer should not be allowed to stand in the measure for more than a minute or two before it is wanted, as with some waters a scum is formed on the top, which, when poured on to the plate, adheres to the film in parts and is some little time before it washes off. It will not be noticed at the time, but afterwards it will be found to have held back development a little, and so to have marked the negative in a way which is incurable except by the most elaborate retouching. The liquid should not be splashed over the surface of the film, but holding the dish in the left hand and the graduated measure in the right, the side of the dish furthest from the body being higher than the other, the broad edge of the measure, not the lip, is put over the edge of the dish, at the left-hand corner, and then the measure is slid along to the other edge of the dish, raising it so that by the time it gets there it is empty. At the same time the dish has been brought level. The two actions are difficult to describe, but ridiculously easy to perform, and the result is that a smooth even wave of developer passes over the whole plate, pushing off any dust that may be on it, making no splash, and leaving no air-bells behind it. This may be tried in daylight once or twice first; and then its effectiveness will be seen.

No plate, however the length of development is determined, ought to be exposed to the light of the dark room all the time. A cover for the dish may be extemporized from a piece of card, or a larger dish may be used, or a cover may be made and kept for the purpose. A flat board with a narrow ledge round it within which the cover fits, and a fillet about a quarter of an inch in depth and an inch wide running across the middle of its under side, makes it very easy to rock the dish without having to hold it in the hand to do so.

As the addition of bromide to a developer is a thing to be deprecated, and as the action of development leads to the formation of bromide in the solution, the prolonged use of the developer is not to be recommended at any time. In certain cases, such as that of bromide paper, where the developer is one with a high development factor, and therefore very little affected by small quantities of bromide, and

VENICE—EARLY MORNING

BY R. CHILD BAYLEY

where the developer is plentiful and strong while the film itself is thin and not so rich in silver as a plate, it is found economical and harmless to use the same developer over and over again; until, in fact, we are warned by the colour of the prints, to change it for fresh. But in negative work, it is a poor economy, both because of the uncertain composition of the solution and because of the greatly increased risks of staining the film.

After development and before fixing, the negative should be slightly washed. If development has been determined by the eye, the backing will have been removed from a backed plate already. Some workers wash it off before starting to develop, and thereby introduce the risk of air-bells on the surface of the film, to which reference has already been made. In time development, whether by the Watkins method or pure and simple, the backing may be left to come off, or at least to soften in the development and fixing. A common plan for those who do not use time development, is to wait until the image is well out on the plate, and then to remove the backing under the tap, replacing the plate in the solution to finish developing. No harm is done by the intermediate washing. To get rid of the backing the plate should be held, back downwards, with a gentle stream from the tap running into the centre of the film. A nail brush or a rag may be used to rub the underneath side, to dislodge any backing that may remain, which will then be carried off by the water. If the plate is held back upwards, the water carries the backing on to the film. Though many photographers take a negative straight out of the developer, and put it into the hypo, there is always a risk of marks and stains when so doing; some developers being particularly prone to cause them. It is well known that a developer coming into contact with a solution which contains a silver salt is liable to give rise to metallic marks in the film and to the once common, but now almost unknown defect, dichroic fog. The film of a plate put straight into hypo while full of developer gives precisely the conditions required for the production of such fog. Hence arises the necessity for a preliminary wash, which need only be a rinse under the tap for half a minute, but should not be omitted.

Only two forms of fixing bath have any wide popularity,

the plain hypo solution and acid hypo. For negatives, a solution of four ounces of hypo in a pint of water answers every purpose. It ought to be made up some time before use, to get to the temperature of the rest of the solution, as when hypo dissolves, the solution becomes for the time being very cold. Hypo is decomposed by almost all acids, with the formation of sulphur. Sulphurous acid is an exception ; and as sulphurous acid has powerful anti-staining properties, many like to have it present in the fixing bath. Such a bath is known as an acid-fixer. The simplest way to make it would be to add the sulphurous acid direct, but the acid is not a very pleasant compound to have about. As a substitute, therefore, it has been customary to recommend making a solution of sulphurous acid by adding sulphuric acid to a solution of sodium sulphite, and adding this. The sulphite and the sulphuric acid must not be added separately to the hypo, or the acid will at once decompose it. They must first be mixed. For this purpose the following formula will be found effective :—

Sodium sulphite (crystals)...	1 lb.
Sulphuric acid	2 ozs.
Water	80 ozs.

One ounce of this solution is added for every two ounces of hypo in the bath. A simpler plan is to add two drams of potassium metabisulphite to the bath, to each pound of hypo. As the metabisulphite is a strongly acid salt, in fact, sulphurous acid can be recognized in it by the smell alone, this requires the addition of no sulphuric acid as the sulphite does. In making up the solution of sulphite and sulphuric acid just described, it is important not to increase the quantity of the acid, as free sulphuric acid in the fixing bath would be most injurious.

Whether plain hypo or an acid fixer should be used for negatives is largely a matter of opinion. There ought to be no difference in the cleanliness of the negatives ; but those who are at all troubled with stains or scum marks will find the acid-hypo, if not a complete preventive, at least a palliative. It is much more expensive than the plain hypo. It does not discolour in use ; but this is not an unmixed good, as it may lead

to the fixing bath being kept and used after it is actually too exhausted to ensure complete fixation. This leads us to consider the manner of its action on a plate.

If we take a negative, and, watching it carefully, remove it from the hypo as soon as the white appearance at the back has gone, wash it, dry it, and place it in a strong light, as would be the case if we were going to print from it, the film will in time turn brown, probably only in patches, and the negative will be ruined. If we had left the negative in the hypo for twice as long, this would not have occurred. The function of the hypo is to dissolve the silver bromide and iodide left in the film and unused in the formation of the image. Hypo acts upon these silver salts immediately, forming salts known as silver thiosulphates. These salts are not readily soluble in water, but are soluble in a solution of hypo. The sign that they have been formed is the disappearance of the creamy bromide and iodide in the film, best seen at the back of the plate; but this disappearance is only a sign that the first stage of the fixing is complete. The thiosulphate is formed, but it is still in the film, and has got to be removed, and its removal must be effected by the solution of hypo itself. For this reason, therefore, the common rule is to leave a plate in the fixing bath as long as is required to get rid of the creamy appearance, and as long again. It is a safe rule, and, in the absence of any other indication to guide us, is the best we can do. But it is purely empirical.

We have already seen that acids, except sulphurous acid, decompose hypo. The same decomposition is caused by alum, but more slowly. This decomposition is a very dangerous one to the stability of the image in both negatives and prints, and is a thing to be guarded against by all who wish their photographs to last longer than a few months. For this reason, then, alum and hypo, except when their mutual action is employed deliberately for toning, as will be described later, must be kept strictly separate. In hot climates and under trying conditions generally, gelatine plates and films may frill and blister. The remedy usually suggested is an alum bath, and alum certainly hardens the gelatine and renders it less susceptible to such defects; but carelessly used, the alum may cause troubles worse than it prevents. Stains and blotches,

which may only appear some time after the negative is finished, form one of its manifestations. A worse, and totally incurable defect, is a patch of a light colour, best seen from the glass side, looking for all the world as if the plate were insufficiently fixed, but resisting the most prolonged action of hypo. Both are caused by putting a film containing alum into a solution of hypo, or *vice versâ*. No harm results if the alum is washed out before the plate is put in the hypo, or if the hypo is removed before the alum bath is applied.

In temperate climates, if there is much trouble from frilling or blistering, it is far better not to attempt to correct it by means of alum or other hardening agents, but to discover the cause and remove it. A great difference between the temperature of the different solutions in which the plate is put will cause it. A caution has already been given against the cold water pipe to the dark room being led for any distance side by side with a hot water pipe. The writer knew of a case where this occurred and gave rise to persistent frilling, although the temperature of the water was never high enough to be noticed. In another instance, the relief pipe of a hot water heating apparatus discharged into a cold water tank from which the dark-room supply was drawn, and caused countless failures, until they were finally traced to their source. Another factor which may tend to produce frilling, is the employment of a developer containing caustic alkali, or even a great quantity of carbonate. Hydrokinone is sometimes employed with caustic soda or potash as the alkali, and these have a great softening effect on the film of gelatine. So has ammonia. Careless handling of the edges of the plate during development may lead to frilling, and if a large plate has been unskilfully cut up, that, too, may bring it about.

After fixing, it only remains to get rid of the hypo in the film for the negative to be finished. This is done by washing. Important as is thorough washing, thorough fixing is still more so, and repeated experiments have shown that a plate that is completely fixed will carry a good deal of hypo in its film without being seriously affected thereby. At the same time, every negative should be thoroughly washed, both to ensure its permanence and to allow of the application to it of other processes, such as intensification or reduction, with either of

which the presence of even a trace of hypo would be most detrimental. The importance of the washing process has led to the most exaggerated and mistaken ideas of the time which should be devoted to it, and of the method of carrying it out. It has also led to the introduction of chemical "hypo-eliminators" intended to decompose the last traces of hypo in the film and so render them harmless. The worst of it is, that the hypo itself is harmless until decomposed; and, in some cases, at any rate, the product of the decomposition of the hypo is certainly more deleterious than the unaltered salt itself. The best hypo-eliminator is water, and it can do its work completely in half an hour.

Let us suppose for a moment that we have a negative which we wish to wash as quickly as possible, but wish also to be confident that the washing has been thorough. On taking it from the hypo, it is rinsed under the tap and placed in a dish of water. At the end of two minutes it is taken out and stood up to drain, while the dish is rinsed out and filled with clean water. The drained plate is put into it for another two minutes, again put up to drain and the dish rinsed and refilled. At the end of half an hour the negative will have had about ten changes, and, as has been shown by the work of MM. Lumiere and Seyewetz, is as completely freed from hypo as is reasonably possible—quite as completely as is demanded to ensure permanence.

The use of "hypo-eliminators," as they are called, seems to be very tempting to some, on account of the supposed saving of trouble and of washing water. There is no doubt, however, that if the washing is carried out in dishes, as directed above, it will be no more trouble, and certainly will use no more water, than any process involving the application of chemicals to destroy the hypo. Because whatever is used we must get rid of the products of the destroying action by washing. A saturated solution of alum applied for an hour or two is said to get rid of the hypo; but as the action of the alum is practically that which the photographer fears if hypo is left in the film, the remedy is worse than the disease. Sodium hypochlorite, potassium persulphate, and hydrogen peroxide have all been recommended, but are of very doubtful efficacy. Lately the use of water just tinged pink with potassium permanganate

has been suggested. This is employed instead of plain water for washing. The hypo destroys the pink colour, and so is known to be eliminated when the characteristic tint of the permanganate solution remains after the liquid has been in contact with the plate for a minute or two. The solution must not be strongly coloured, or the negative may be stained. If it is stained, it is best to finish the washing and then to immerse the negative in a two per cent. solution of oxalic acid until all the stain has gone, and then to wash it again to remove the acid.

Though the advice is often given to wash in running water a negative that is wanted in a hurry, it is very doubtful whether the method described in a preceding paragraph is not more effective, in the same time, than placing the negative under the tap would be. It is not so much the constant changing of the water as the thorough draining in between each change which is so effective in getting rid of the hypo. Careful experiments have shown that popular ideas as to the efficacy of rinsing are mistaken. We fill a glass with a solution of some salt or other, empty it out, rinse it a few times in clean water, and assume that by so doing we have got rid of the saline matter. But it is by no means the case; and the solution will be found to cling to the glass, and by delicate chemical tests to be present in quite appreciable quantity after the rinsing. If this is so with the smooth polished surface of a glass, how much more is it to be expected in the case of the spongy absorbent film of gelatine? If we could squeegee it between each rinse we could accelerate washing, but the film is too tender for that.

Cut films are not easily washed in the same apparatus that is used for plates, as, unless they are exceptionally stiff, they will not remain in the grooves like a glass plate. Two, back to back, may be placed in the grooves if they are fairly stiff, and have a piece of glass between them. Or they may be washed in a dish like prints. They can also be washed by suspension in a tank. A long length of roll film may have one or two split shot (which are supplied at any fishing tackle warehouse) nipped at intervals of a few inches along the edge. Along the opposite edge are placed small corks, the cork being slit with a sharp knife, and the extreme edge of the film slipped

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in. Such an arrangement will float vertically in a large vessel of water; the domestic bath answers excellently. If there is a depth of a foot or so below the film, and it has been rinsed once or twice before immersion, and is rinsed once or twice afterwards, two changes of the water in the bath at intervals of an hour will wash the films effectively. Another plan is to fasten the film with drawing pins to the surface of a board, and float that on the water, film downwards. As there is a gelatine coating on both sides of non-curling "roll" film, the film should not be fastened flat to the board, but bowed so that the water has access to the back also. The image-bearing film must be outwards of course. Films that have been cut up can be washed by inserting one edge in a slit in a cork, and floating them in a vessel of water.

If we examine the surface of a negative after it comes from the washing water, we are almost certain to find it covered with a whitish deposit, or with a scum—the former when the washing water is hard, the latter when it is soft. It will not do any great harm if it is left on, but it is easily removed by holding the plate, film upwards, under the tap, and rubbing the surface gently with a mop of cotton wool. This certainly improves the appearance of the finished negative. It may then be dried. The grooved racks which are sold for drying negatives are very convenient, but on no account must a plate be put in each pair of grooves. The grooves, as a rule, are far too close together for this to be done. An inch or more at the very least should separate the plates, if they are half plates or smaller, while if they are larger this distance should be increased. Drying must not take too long, nor must it be irregular. The wet film is an ideal culture ground for bacilli and mould, and defects in negatives have been directly traced to such causes. The sooner the plate is dry, therefore, the better Before standing the plates in the rack, the glass side should be wiped dry with a clean cloth. Drying is hastened by taking up from time to time with a strip of blotting paper the drop of water that collects at the bottom corner. It might be worth mentioning for those who suffer from the insects, that "black beetles" regard the damp gelatine film of a negative as a particular delicacy.

The rate at which the film dries has a distinct effect upon

CHAPTER XII

INTENSIFICATION AND REDUCTION

Intensification—Different processes required by different forms of thinness—Fog—Different reduction methods—Wellington's silver process—Mercury-ammonia—Mercury-ferrous-oxalate—Chromium intensification—Mercuric iodide—Monckhoven's intensifier—Ferricyanide and hypo—Ammonium persulphate—All such processes are only makeshifts.

THE finished negative may or may not be precisely what we require. If it is not, there are a number of processes at our command by which it can be modified. Some of these are chemical, and are applied usually, though not necessarily, to the whole negative; others are mechanical, and lend themselves particularly to local application. If the negative is too thin to print by the process we propose to adopt, it can be intensified; if it is too dense, it can be reduced. There are several reliable methods at our command in either case. No methods have been the subject of more complete misunderstanding than those of intensification and reduction. It is customary to say that if the negative is too thin it can be intensified, to give one or two methods of intensification, and there to leave it. Reduction is treated in the same way. The fact is that thinness may be due to one of several causes, and each particular kind of thinness must be dealt with in a particular way if it is to be remedied. Some methods of intensification applied to some thin negatives might make the last state of those negatives worse than the first, although in other cases the method might be most valuable. Before anything is done, therefore, either in the way of intensification or of reduction, it is most important to diagnose correctly the shortcoming of the negative.

Taking first the case of negatives that are too thin to give a good print, there are three distinct causes for such thinness, and these demand three distinctly different remedies.

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BY E. T. HOLDING

The first cause is under development. The negative has been correctly exposed, but was taken out of the developer too soon. If such a negative is placed face downwards on a sheet of white paper—its edges should be quite clean—there should be some signs of an image in the deepest shadows, and there should be distinct difference of gradation right from the shadows to the highest lights, although these differences are not great enough to give as vigorous a print as can be desired. It may have been over-exposed and under-developed, a very common defect, since it follows inevitably if the Watkins factorial method of development is applied to an over-exposed plate; and most workers who do not adopt time development under-develop over-exposed plates from inability, from excessive density, to see how development is progressing, or from a desire to avoid halation. Whether the plate is correctly or is over-exposed, the thinness is due to insufficient development, and the remedy is the same. What is wanted is intensification as far as possible in proportion to the amount of deposit already in the film. The best intensification for such negatives is by Wellington's silver method, but the ordinary mercuric chloride, followed by ammonia or by ferrous oxalate, will be found to answer. In the case of over-exposed plates the mercuric chloride and ammonia is better than the others, but the difference is not very marked. Another remedy is what is sometimes called "chromium intensification." If the image on a negative is bleached in an acidified solution of potassium bichromate, washed, and then darkened by the application of any ordinary non-staining developer, in daylight, the negative is intensified. A convenient strength of solution is one containing five grains of bichromate and one minim of hydrochloric acid to the ounce. The ordinary amidol developer used for bromide points makes a very good darkening agent.

Thinness may be due to under-exposure. It is often said that under-exposure causes harshness or excessive contrast in a negative, but this is a complete mistake. The harshness is due to over-development, that operation having been carried on too long, with the mistaken notion that perhaps it might bring out detail in the shadows. It never does; the result being merely to make it more difficult than it otherwise would be, to botch up some decently printable negative on the under-exposed plate. Those who doubt this can soon set their

minds at rest on the subject by trying the experiment of exposing three plates on the same subject, giving one a correct exposure, and the other two what is a very decided under-exposure, but giving the same to both. One of the under-exposed plates and the correctly exposed plate are developed side by side for the same length of time, the time being that required to give the negative desired on the plate that was correctly exposed. The remaining plate may be developed as far as possible, in the hope of bringing out detail. Of the two developed together, the correctly exposed plate in every respect will have more deposit and more contrast than the under-exposed plate, showing that under-exposure does not lead to harshness or to excessive contrast, but the reverse. The other plate will doubtless be very harsh; and it will be difficult, if not impossible, to make as good a negative from it as from the under-exposed plate which was developed with the correctly exposed one. Thinness, therefore, may be due to under-exposure. In such a case the best treatment is intensification with mercuric iodide. If mercuric chloride is used, printing density can be obtained, but the print will have all the characteristics of a print from an under-exposed negative; with mercuric iodide, and to some extent with the Wellington intensifier, signs of under-exposure are less noticeable.

The third cause of thinness is extreme flatness in the subject. The silver intensifier will be found much the best for this. This cause of thinness is the least likely to arise, as in the very great majority of the subjects with which photographers, especially amateur photographers, are likely to deal, the subjects are such as to yield negatives of ample contrast on the plates on the market.

There is little profit in trying to intensify plates that are noticeably fogged. The fog being of the same composition as the image, it is intensified at the same time, and before the action has been carried far enough to improve the negative materially, the fog has intensified to such an extent as to make it unprintable.

There are some photographers who claim to be able to improve negatives which are both thin and foggy, by reducing them first, to remove the fog, and then intensifying to obtain contrast. On paper this looks very satisfactory; but although

the author has tried it repeatedly on negatives which looked most favourable for the experiment, it has never resulted in a negative that was in a noticeable degree an improvement on the original. There is a method—Monckhoven's—which improves such negatives a little, as it has a slight reducing action on the thin parts as well as an intensifying one elsewhere, and this offers the best chance, though a feeble one at best, of making a negative that is both thin and foggy into one that will give a fairly good print.

Reduction is the reverse of intensification, and resembles it in this respect, that it is necessary to diagnose the cause of the over density which we desire to reduce, before we can decide which reduction method to apply. Over density may be due to over development, or it may be due to fog. For fog, such a reducer is needed as shall take the same quantity of the deposit off the shadows and the high lights alike. As this form of reduction does not have any great effect on the contrast obtained finally in the print, and only lessens the time which the negative takes to print, it is very seldom that its use is justifiable. It is risky, because if reduction is carried on beyond the stage at which all the fog is removed, and it is not always easy to tell when this stage has been reached, it begins to destroy the gradation on the negative, and no after process can remedy this. Its action, in short, is to make a negative obtained with correct exposure resemble an under-exposed one. Potassium ferricyanide and hypo is the most generally used reducer of this type.

Reduction of this type may sometimes be applied with advantage in the form of a momentary treatment to remove surface stains and clear up a negative generally; but it must be momentary, and must err on the side of incompleteness to make sure that it is not overdone. It is sometimes applied with advantage to lantern-slides to clear them; but the conditions then are altogether different.

When reduction is to be used as a remedy for over-development, a process is needed which will reduce the silver deposit—not equally all over—but in proportion to the quantity of deposit present in the different tones. For this purpose, a solution of ammonium persulphate must be used. It is best freshly made, and after it has been applied for three or four

minutes, it should be poured off, the negative washed, and a fresh lot applied if need be. A weak sodium sulphite bath should be given, after reduction is seen to have gone far enough, followed by a thorough washing.

The negative to be reduced or intensified must first in every case be thoroughly fixed and well washed. All negatives take these processes more easily if they are applied before drying. On the other hand, the application of the solution has a softening action on the gelatine, and may lead to frilling ; drying between washing and the after processes helps very greatly to prevent this. If the negative has been varnished, the varnish must be removed by means of a suitable solvent. Shellac varnishes, such as those which require heat for their application, are made with alcohol and can be removed by means of methylated spirit. The negative is placed in the spirit for a minute or two and gently rubbed with cotton-wool. It is then taken out, drained, and put in fresh spirit, being rubbed with a clean piece of wool. After a minute or two, it is again drained and placed in a third bath in the same way. It is then rinsed under the tap and allowed to soak for half an hour or so in clean water. The spirit, after use, may be employed in lamps ; but holds too much solid matter for most other purposes. If the varnish has been a celluloid one, acetone or amyl acetate must be used in the same way to remove it.

Nothing would be gained by giving particulars of other intensifiers and reducers, which are numerous enough, as their action is not markedly different from those dealt with in this chapter, which should be more than sufficient for all the possible requirements of the photographer. He will do better still if he determines to do without them entirely, relying in every case upon correct exposure and correctly timed development to give him the negative which he requires. No reduced or intensified negative is so good as one produced by the operation of development alone. They are all only means for making the best of a bad job, and although they will work wonders in the way of improvement, the result will never be perfect. All said and done, they only act as effective remedies at all in the case of errors in development. As for plates which have been over or under exposed, they are best reduced—with a hammer.

CHAPTER XIII

THE HAND-CAMERA

Detective cameras—Hand or stand type—The development of the hand-camera—The first "Kodak"—Shutter regulation—Lenses—Fixed focus—Focussing arrangements—What is sharpness?—"Infinity"—The hyperfocal distance—Magnifiers—Finders—Efficiency of shutters—The most useful speeds—Folding pocket-cameras—The reflex—Releases—Levels—Plate—and film-holding devices—Making the exposure—Judging distances—Pictorial photography and the hand-camera—A travel companion—Exposures for different classes of subjects—"Press-the-button" photographers.

WHEN the extraordinary sensitiveness of the gelatine dry plate was realized by photographers, it became evident that a great many subjects could be photographed with so short an exposure that it was possible to hold the camera steady enough for the purpose in the hands, without any stand at all, and apparatus designed for use in this way soon made its appearance. In those (photographically) far-distant days such machines were called "detective" cameras. The popular press to this day has not got rid of the fallacies based on such a name, and one still finds both in avowed and in unavowed fiction accounts of the camera being of service in detecting the villain in circumstances which a very little photographic knowledge would have shown made photography impossible. By way of bringing things up to date, the hand-camera sometimes becomes a kinematograph. It is not so long since we read of a murderer who was convicted and punished on the evidence of a kinematograph machine which "happened to be working at the time." "Detection," however, is not the *métier* of the hand-camera, but rather what has been termed "spur-of-the-moment" photography; and a hand-camera to-day is a piece of photographic apparatus designed throughout to allow the user to photograph anything which he wishes to record with as few and as brief preliminaries as possible. Although, usually, this

implies that the camera will be held in the hand, not used on a stand, it by no means follows that this is necessarily the case. Almost every hand-camera now made is provided with fittings to allow it to be used on a stand, but it does not follow that it is a "stand-camera" in consequence. A popular type, the "folding hand-or-stand" camera, as its name suggests, embodies the requirements of both; but a hand-camera may be capable of being used on a stand and still not be a "hand-or-stand" camera.

The way in which the hand-camera has developed from the stand-camera is easily seen. The characteristic of the latter is its focussing screen, which occupies the place to be taken by the plate, and on which the subject is both arranged and focussed. This is out of the question in any hand-camera; so in place of it we have one or more finders by which the extent of subject to be included in the picture is ascertained, and either a separate focussing arrangement, as in instruments of the reflex type, or a scale by which the camera may be set for objects at some definite distance. The hand-camera must have some kind of shutter; but the essential difference between the hand and the stand types lies in the fact that in the latter the focussing screen is used in the actual position subsequently occupied by the sensitive surface, which is not the case with a hand-camera.

Since the early days of the hand-camera an immense change has come over the photographic world. At first it was regarded as a toy, and one often heard the phrase "Only a hand-camera." Then special classes for hand-camera work were arranged at the exhibitions, classes in which it seemed to be an understood thing that the standard should be lower than it was in the others. Gradually this changed, as the powers of the instrument were increased by improvements in its design, and photographers began to master its possibilities, until now one hardly ever hears of any such distinction; the ablest workers use the hand-camera, and the only way by which there is much chance of distinguishing between hand- and stand-camera work is that the former can deal successfully with problems which with the latter are impossible.

The first hand-cameras were made to take plates; then came the earliest "Kodak," which was designed for use with paper coated with the same emulsion as was used on glass

plates; the substitution of celluloid for the paper followed, and then a number of rivals of celluloid made their appearance. Stouter celluloid was also used in cut pieces in place of plates. Then came the daylight-loading film cartridge, a resuscitation of a device used with the sensitive papers of almost fifty years before; and then, when the use of the stouter cut films in hand-camera work had almost ceased, the film pack was introduced, holding a dozen thin cut films in such a way that they could be loaded into the camera and unloaded in full daylight. Then again the first hand-cameras had some simple sliding or rotating plate as the shutter; this in turn was supplanted to a great extent by the roller-blind shutter, now almost obsolete once more as far as hand-cameras are concerned, except in the highly specialized form of the focal-plane shutter. The early metal shutters had no regulation at all; the notion that it was just as necessary to "time" a shutter exposure as one made by hand came later. When it did come, shutters were slowed down by friction brakes, or by altering the dimensions of the shutter-opening, or by varying the tension of the driving spring. The greatest advance in shutter construction was the introduction of pneumatic control, by which the time of exposure was governed by the rate at which air was allowed to leak out of a cylinder connected with the shutter mechanism. Except in the case of the focal-plane shutter, all the best instruments now made have pneumatic control.

Such were the stages in the evolution of the modern hand-camera. The box form, which was that first used, persists to this day, in spite of its bulkiness. In fact some of the latest designs are some of the bulkiest, the user of the reflex being willing to accept the drawbacks of bulk and weight in return for the undoubted advantages conferred by that type. There has been much ingenuity bestowed upon the design of extremely portable folding cameras, some of these being marvels of compactness; but these are mere concessions to comfort and luxury, and do not have much bearing on the technical side of the instrument. While the special features of the hand-camera have been worked out and improved, there has gone on the improvement in lenses and the increased sensitiveness of plates, which has been referred to elsewhere. On no form of photographic work have these two lines of advance had

greater influence. They have had the effect of transferring into the sphere of the hand-camera many subjects which a few years ago would have have been considered as outside its scope, and have played quite as large a part in the development of hand-camera work, if not indeed a larger one, than the improvements in the instrument itself.

It is rightly considered that the most important feature of the hand-camera is the lens, and in no branch of photography can money be laid out to greater advantage in obtaining an instrument of the best class. In writing thus, we do not suggest that excellent work cannot be done with quite simple and low-priced apparatus—the possibility of this has already been shown—but the capability of dealing with a large variety of subjects and of working under unfavourable conditions is bound up with the use of a large-aperture anastigmat of high quality. When a lens of comparatively long focus is to be used, say for example a 10- or 12-inch lens on a quarter-plate, the difference between an anastigmat and a rectilinear may not be noticeable, when both are used at F/8, or thereabouts; but if it is a 5- instead of a 12-inch that is used, the superiority of the definition given by the anastigmat towards the edges of the field is very evident. It is not only that the anastigmat works at a larger aperture, although that, of course, is often very valuable, but that at the same aperture its marginal definition is so much superior. The actual increase in rapidity is often neutralized by the want of depth of focus when such large apertures are used, and by the difficulty of focussing accurately by scale. Many a hand-camera worker has gone from a simple rectilinear working at F/8 to a high-class anastigmat at F/6, and to his surprise has found that the definition of his photographs is worse instead of better. He has to learn to use the more rapid lens more accurately, and to realize that whereas there are many subjects for which it is invaluable, there are many others with which it must be stopped down to F/8, or less, if the definition of both near and distant objects is to be equally good. That the better lens gives him greatly increased powers, if he knows how to utilize them, there can be no doubt at all.

In the very simplest forms of hand-camera there are no focussing arrangements at all; the apparatus is of the type known as "fixed focus." That is to say the lens is fixed at

such a distance from the plate or film that subjects of the kind most likely to be photographed will be fairly sharp. We shall see later on how this is possible. It is not a merit, but a defect of the apparatus. Any one who does not wish to have to focus can convert his camera into one of "fixed focus" with a nail and a hammer, or can work on such lines by the still simpler method of not focussing; he will then have the advantages of fixed focus, such as they are, together with all the possibility of focussing as soon as he learns how much is to be gained by doing so. To work at "fixed focus" the camera must be set so that very distant objects are focussed almost but not quite sharply, the sharpest definition being on something nearer. The largest size of camera with which fixed-focus work is at all practicable is quarter-plate; and a 5-inch lens working at F/11 on this size should be focussed on an object in the middle of the field about 20 feet away. When so set, it will be found that everything 10 feet or more from the camera is fairly sharp, as long as it is near the centre of the picture. The definition towards the edges will depend quite as much on the quality of the lens as on the distance of the object, and cannot be specified beforehand. With cameras smaller than quarter-plate, fixed-focus work is more satisfactory, as, other things being equal, the smaller the picture the easier it is to get near and distant objects sharp at the same time. But where the photographer expects to be able to enlarge the best of his negatives, he will find that even with very small sizes the "fixed focus" type of apparatus is not satisfactory; and all the best of modern cameras, however small the picture obtained, are now provided with some method of adjustment for focussing.

The commonest focussing device is by means of a scale and pointer. The user estimates the distance of the object which he wishes to have in the sharpest focus, and sets the camera accordingly. This is usually done by racking the front in or out; but in some cases it is the lens only which moves, being fixed in a tube provided with a screw thread of great pitch, so that on rotating the tube it moves backwards or forwards. In one case at least focussing is effected by altering the separation of the different glasses composing the lens, and a very common plan is to focus by putting close in front of the lens

proper an additional lens known as a "magnifier." The effect in each case is the same. The distance at which objects must be to be rendered sharply in the photograph is controlled; and it becomes of importance that the photographer shall know something of "depth of focus."

If we select some distant object so small that its image in the camera is a mere point of light, and focus it as sharply as we possibly can by means of a magnifying glass, we shall find that the focussing screen can be moved a little in either direction without the point becoming perceptibly fuzzy or indistinct, although when looked at with the magnifier it is seen to be so. As all focussing on subjects containing objects at different distances is a matter of compromise, it becomes necessary to know how much indistinctness is permissible. When a photograph is made to be looked at with the naked eye at a normal distance, and not to be peered into for fine details, it has been commonly accepted by opticians and photographers that the image of such a point of light as we have just supposed may be widened or blurred until it is no longer a point, but a disc of a diameter of a hundredth of an inch, without being considered to be unsharp; on this basis tables of "depth of focus" have been worked out. They are said to be based on a "circle of confusion" of one-hundredth of an inch. As such tables of depth of focus are hardly ever used except in hand-camera work, and as almost all the best hand-camera work is subsequently enlarged, there seems to be no doubt now but that this commonly accepted permissible "circle of confusion" is decidedly too large, and that such tables call for revision on a stricter basis.

We have seen in Chapter VII that the power of rendering sharply near and distant objects at the same time is not a thing which depends on the type of lens, but is governed by its focal length and by the size of the stop. "Depth of focus"—which should properly be termed "depth of field," but the former expression has been sanctioned by usage—can therefore be tabulated; and when we know the focus of the lens and the F/- number of the stop which is going to be used in it, we can calculate the limits within which we may expect to get the image sharp, so far as that sharpness is affected by the distance of the object from the camera. Thus, for example,

if we are using a lens of 6 inches focus with F/11 as its stop, and we focus sharply on an object 12 feet away, calculation shows us that all objects from a little more than 8 feet up to not more that 22 feet from the camera will be in sharp focus. One ought not to say "in sharp focus" to be strictly correct, but rather that they will not be blurred more than is represented by a "circle of confusion" of a diameter of one-hundredth of an inch. This will only hold good of the ideally perfect lens, and of objects in the centre of the picture; but it is useful to know how far one may expect the "depth of focus" to extend, in order to know to what extent poorness of definition may be fairly attributed to imperfections of the lens.

One soon finds on using a camera that a great deal more blur or out-of-focus effect is permissible with distant than with near objects. A hill in the background of a landscape may be rendered with a fuzziness that would be instantly noticeable and condemned in the leaves or grass of the foreground, without any one raising any objection or even becoming conscious that it is not sharp. In portraiture, too, the same thing is observable. So long as the most important features of the face are not blurred, a softening of the definition elsewhere may be allowed to pass, while some little diffusion of the background is useful as helping to keep it properly subordinate to the figure. This, however, is a pictorial consideration, and is not one which could be allowed to enter into the calculation of depth of focus, although it must be given due weight when tables or focussing scales are being used.

A moment's examination of the focussing scale on a camera shows that the nearer the objects are to the camera the greater is the effect of any alteration in their distance. Thus, if an object 6 feet away is moved a couple of yards further, the movement of the lens that becomes necessary to bring it once more into focus is very much greater than if the object had been 20 yards away and had then been moved 2 yards, while beyond a certain point, known as the "Infinity distance," no further increase in distance calls for any further adjustment of the camera. In making a scale for a camera, the first point to decide is the position of the "Infinity" mark. In practice, this can be settled very easily if the camera can be fitted with a focussing screen for the time being. The lens

is then turned on the most distant convenient object, anything more than three or four hundred yards away may be chosen, and this is focussed as sharply as possible. The position of the camera then will be at the *true* infinity mark ; and if we turn it from the object three or four hundred yards away to one more than two hundred thousand miles away, the moon to wit, we shall find that it also is sharp. Such a position is of little use to the photographer, however. We have just seen that a little blur in a distant object is permissible, but in a near object is at once noticeable; so that instead of treating as "infinity" the point at which the most distant objects are at their greatest possible sharpness, the camera must be racked out a little, so as to transfer the distance of greatest sharpness to objects a little nearer. The image of the extreme distance is observed carefully while doing so, and as soon as the movement has gone as far as it can be carried without making that extreme distance too fuzzy, it is stopped. This is the point at which the working "infinity" mark should be placed, and an object which is then represented at its sharpest is said to be at the "hyperfocal distance." A very little experience with the camera will show that the "hyperfocal distance" varies with the length of focus of the lens, with the stop, and with the "circle of confusion" which is permissible.

The hyperfocal distance has this property also. If we focus very carefully on an object at the hyperfocal distance, the most distant objects will be just within the limits of permissible blurriness, and, in addition, all other objects up to a distance from the camera of one-half the hyperfocal distance will also be within those limits. Thus, for example, with a circle of confusion of one-hundredth of an inch, the hyperfocal distance of a 5-inch lens at F/8 is 26 feet. In other words, if we focus with such a lens on an object 26 feet away, everything more than half that distance, that is to say everything 13 feet or more from the camera, right up to the most distant object possible, will be in focus. This must not be taken to mean that it will all be what the photographer calls "dead sharp"; but it will all be within the limits of permissible blurring, which are laid down by saying that the "circle of confusion" does not exceed a hundredth of an inch in diameter.

It is very easy to find out the hyperfocal distance by calcu-

lation ; and as it will tell us other things about our apparatus which it is useful to know, we will see how it is done. First, we settle what shall be the permissible blur ; we will suppose this to be the usual "circle of confusion" of a hundredth of an inch. The focus of the lens in inches is squared, the result is multiplied by one hundred, and the product is then divided by the F/- number on the stop. The dividend is the hyperfocal distance in inches. Thus a 10-inch lens at F/8 has a hyperfocal distance of $10 \times 10 \times 100 \div 8 = 12507$ inches $= 104$ feet 2 inches. If the circle of confusion is to have a diameter of $\frac{1}{200}$ or $\frac{1}{300}$ of an inch, we multiply by 200 or 300 instead of by 100. It is well to construct a depth-of-focus table for oneself for the lens in use, first finding the hyperfocal distance for each of the stops, or at least for each of the larger ones. It is not generally practicable to refer to such a table at the moment of making the exposure ; but it is valuable as showing what to expect.

The limits of sharpness for each graduation of the scale can be calculated when the hyperfocal distance has been found. To find the limits, the hyperfocal distance in inches with the stop in use is multiplied by the distance in inches of the object focussed, or the distance for which the scale is set. The result so obtained is divided twice, first by the hyperfocal distance plus the distance focussed for, which will give us the nearest distance at which objects will be sharp, and then by the hyperfocal distance minus the distance focussed for, which will give us the furthest distance at which to expect sharpness. This will be made clearer, perhaps, by an example, and we will take for the purpose a 5-inch lens which has stops F/8 and F/11. The hyperfocal distance for these stops, calculated in the way just described will be found to be, for F/8—312 inches, and for F/11—220 inches. If, then, the scale on the camera is set at 9 feet (108 inches) we first multiply the hyperfocal distance by this. Taking F/8 first, the stages are as follows :—

$$312 \times 108 = 33696$$
$$312 + 108 = 420$$
$$312 - 108 = 204.$$

Then $33696 \div 420 = 80$ inches $= 6$ feet 8 inches.
and $33696 \div 204 = 165$ inches $= 13$ feet 4 inches.

So that a 5-inch lens at F/8 focussed for 9 feet will give us everything sharp that is not nearer than 6 feet 8 inches or further than 13 feet 4 inches. Proceeding in the same way, we learn that on stopping down to F/11, keeping the indicator at the same point of the scale, we should get everything sharp up to 6 feet, and not more than 17 feet 7 inches.

It will usually be found that the "infinity" mark on most cameras is somewhere about the position for the hyperfocal distance with the largest stop; but if we are making a scale for the camera it is useful to know the true "infinity" mark at least temporarily. If we find it by focussing some very distant object, and then, having marked it, we focus an object at the nearest point which we wish to have on the scale, we can interpolate other distances on the scale without refocussing. Thus, if we have the infinity mark and the 4-feet mark, a position midway between the two will be the point at which objects 8 feet away are in focus. Midway between that point and "infinity" will be the point at which objects 16 feet away are sharp, and midway between that and "infinity," 32 feet. The results are not absolutely accurate, but are as near as are required. It will be found that for ordinary work, the most useful distances to have marked on the scale are 6, 9, 12, 18, 24 feet and "Inf.," which last should be the hyperfocal distance with the largest stop.

The effect of adding to a photographic lens a supplementary lens or magnifier is to alter the focus of the combination. If the supplementary lens is actually a "magnifier" or positive lens, the sort of lens which is used in the spectacles of a "far-sighted" person, the focus is shortened; if the added lens is a negative or diminishing lens, such as is used in spectacles for short sight, it lengthens the focus of the lens to which it is added. Both kinds of supplementary lenses are sold as "magnifiers." So long as the added lens is not a very powerful one, or the combination is to be used with a small stop, there is no need for these "magnifiers" to be achromatic or compound lenses: a simple spectacle lens will suffice. But the best of them are achromatized. The usual place for a magnifier is just in front of the other lens, and as close to it as possible. It is easy to see how focussing

is accomplished by such a lens. If the camera is one in which its lens is fixed at "Infinity," any positive lens added to it will cause it to be focussed for an object distant from the camera, the focus of the added lens. If, for example, we have a magifier of 3 feet focus, and this is fitted close to a lens already focussed for infinity, we shall find that objects 3 feet away will be in sharp focus with the combination so formed. The addition of a negative lens has already been dealt with as telephotography; it is of no service for focussing a fixed lens, but is useful as a means of temporarily lengthening the focus ot a lens.

A positive magnifier, added to another lens, shortens its focus to an extent which can be calculated when the focus of both lenses is already known. The focus of the combined lens is found by multiplying together the foci of the two lenses, and dividing the product by the sum of the foci with the separation subtracted. Thus, when a 12-inch magnifier is added to a 5-inch lens, the separation of the lenses being 1 inch, we have

$$(12 \times 5) \div (12 + 5 - 1) \quad = 60 \div 16 = 3\tfrac{3}{4}$$

So that a magnifier of 12 inches focus would reduce the focus of a 5-inch lens to $3\frac{3}{4}$ inches. When dealing with the comparatively small and simple lenses used in this way for hand-camera work, this may be taken as giving a general idea of the result of using a magnifier, if the separation is taken to be 1 inch. For accurate results the separation must be the distance apart of the optical centres of the two lenses, which points may be outside the glasses composing them, and can only be found by a more or less elaborate trial.

As the addition of a magnifier shortens the focus, it lessens the F/- numbers of the stops. If we halve the focus, F/8 becomes F/4, for example. Therefore if a lens, after having a magnifier added, were refocussed on the same subject, the exposure required would be shortened, according to the new F/- values given to the stops. So long as magnifiers are used as a means of focussing near objects with cameras in which the distance between lens and plate is fixed, they do not affect the exposure, however, since any gain obtained by shortening the focus of the lens is neutralized by the fact

that the object is so much nearer that the distance between the lens and plate remains the same. In other words, the condition under which a magnifier calls for an alteration of the exposure is the very condition which the magnifier is generally used to prevent. If, for some special purpose, a lens of greatly increased rapidity is needed, and one is willing to sacrifice some of the definition to get that rapidity, as is sometimes the case in night photography and similar work, a magnifier may be found useful by the way in which it shortens the focus, and so lessens the F/- number of the stops; but it does not follow that every lens will stand the use of a magnifier that is powerful enough to be of much service, and this would have to be ascertained by trial. However, all this has no connection with hand-camera work.

The finders with which a hand-camera is provided should enable us to see by a glance in them what we should get on a plate were it then to be exposed. This no finder can do with absolute accuracy in all circumstances, except the finder in a reflex camera, which, strictly speaking, is not a finder at all. Most users of hand-cameras expect altogether too much from a finder. Although many finders are by no means as accurate as they easily could be, it does not follow that, because there is a difference between the finder image and that which reaches the plate, that the finder is improperly fixed. Besides, it should not be forgotten that many modern hand-cameras are made in large quantities, and produced so that they can be sold at a price which is much less than it would cost not to make, but simply to test the camera when made, if each was to be tested singly. The National Physical Laboratory will undertake to test a shutter, and charge for doing so what is a very moderate fee; but the fee is not very much less than the price charged for a justly popular and very serviceable shutter, which is turned out thousands at a time. This applies all through with modern commercial articles manufactured in quantity; and the best way to deal with them is to take full advantage of the method of manufacture by buying at the low price which it makes possible, and then, as far as one can, to do the personal testing and adjustment oneself. This is certainly the case with the finders of a cheap hand-camera. When bought, the finder should

be so fitted that a distant object, seen in the centre of the finder, will be shown in the centre of the negative. As far as distant objects are concerned, everything which is included on the plate should be included on the finder. More than that one is not likely to get. If, as is probable, the finder shows more than is obtained on the plate, this should be corrected by blocking out the excess on the finder with a little Brunswick black and a small brush.

It is easy to see how a finder cannot possibly be accurate in all circumstances. The lens of the finder is not coincident with the camera lens. If we take as an exaggerated case an object only 2 or 3 inches away from the camera, it may entirely block up the finder and yet not be in the field of view of the lens at all, or *vice versa.* This would not be likely to occur in practice, but it serves to illustrate the point with a forcible example. The farther such an article is away from the camera the less is the difference between the finder and the lens images. If the camera has a rising front, as soon as this is brought into use the finder, if it is one of the ordinary type, like a little camera, becomes unreliable. It is not sufficient to mount it on the front, so that it rises with it; this makes practically no difference at all to the finder image. Some finders have been made with a rising front themselves, and a scale, so that this can be adjusted to the rise in the camera front; but this is a requirement which is easily overlooked in the hurry of using the camera on some rapidly changing subject. Others have marks upon them to indicate what is included and what is excluded when the rising front is used.

A type of finder which has its admirers, although it is not at all popular amongst the generality of hand-camera workers, consists of a light metal frame provided with cross-wires and a piece of metal with a small eyehole in it. If the opening in the frame is the size of the plate, and the distance of the eyehole from the frame is equal to the focus of the lens, the two may be fitted on the top of the camera so that the eye placed at the eyehole sees approximately the same quantity of the subject, surrounded by the frame, as will fall on the plate. If the frame is fastened on the front so as to rise and fall with it, such a finder gives a truer indication than any other, except the reflex. This finder has only one drawback—it limits

the possible positions in which the camera may be held to those in which the eye can be applied to the eyehole; and these, as a rule, are not the positions for the steadiest holding. On the other hand, it is the only type in which the camera gives conveniently, and almost invariably, the view as the eye sees it—that is to say, from the height of the observer's eye from the ground or thereabouts. It really deserves a much greater popularity than it has had.

Those who use any other type of finder, therefore, must be content to employ the finder as an approximate indicator only, and must not expect a degree of accuracy that we have seen to be impossible. An ample margin for contingencies should be left all round the subject, so that we may be certain of getting what is required somewhere on the plate. The print may then be trimmed to give the arrangement which is best. This is particularly the case with "brilliant" finders, some forms of which show a different picture according to the position of the eye with regard to the finder, although all forms do not have this failing. Those who want to work very closely to the edge of the plate must use a reflector camera, which is the nearest approach to the ideal form of hand-camera, though of necessity the heaviest form and the most expensive.

Instantaneous shutters are not limited exclusively to hand-cameras, but are best considered here, as with a hand-camera a shutter is a necessity. There are two principal forms—those which have one or more metal plates which pass across the lens, and those in which the moving part is a flexible blind on rollers. The latter type is at its best in the focal-plane shutter, so called because it lies almost in the focal plane of the lens—that is to say, as close as possible to the plate. This type generally can be made to give a higher speed than any other, and, ordinarily, a higher efficiency.

The only other positions occupied by the roller-blind shutter are immediately before and immediately behind the lens. Neither position is a good one; and, except for its cheapness and compactness, the roller-blind shutter would not be used except at the focal plane; because it is not remarkably efficient elsewhere, and labours under the disadvantage that its speed is controlled by varying the tension of a spring, never a very satis-

SANTA MARIA DELLA SALUTE

BY PERCY LEWIS

factory method. As it is, the roller-blind shutter is, for stand-camera work, the most popular form of all. The blind requires attention from time to time, as long usage has a tendency to form pinholes in it. It is said that one or two small holes can be covered with black court-plaster, but a better plan would be to get a new blind as soon as a hole is noticed, since one is sure to be but the precursor of many. The roller-blind shutter, except in the focal-plane patterns, is not much used on hand-cameras.

Most hand-cameras have metal shutters. The best position for these is between the combination of a doublet lens, or close to the stop of a single lens. Such shutters may either open and close from the centre, in which case while opening and closing they act more or less as a stop, or they may have an opening which passes across the lens.

The term "efficiency" applied to a shutter refers to the intensity of the light admitted at different stages of the exposure. It is manifest that during a part of the exposure only part of the lens is uncovered; some shutters, in fact, begin to cover up the lens again as soon as ever it is fully uncovered. The shutter of perfect efficiency would uncover the whole lens simultaneously and instantly, would allow it to remain fully open during the whole time of the exposure, and would then as instantly close it. The best shutter is far from doing this. Opinion is divided as to which is the best from the point of view of efficiency; but there seems to be little room to question the superiority of the focal-plane type so long as it is used as near as possible to the plate and with a fairly wide slit. A special form of diaphragm shutter, the "Multi-speed," has been very highly spoken of by Dr. Adolphe Abrahams, as apparently of even greater efficiency than the focal-plane; but it is very difficult to compare two shutters of distinct types, especially as efficiency varies very much with conditions which are outside the shutter proper. For example, we have seen that the efficiency of the focal-plane shutter depends on the nearness of its blind to the plate, while in all diaphragm shutters the efficiency is greater the smaller the lens to which the shutter is fitted or the smaller the stop used. If we could always be sure of using quite a small stop, the diaphragm shutter would leave nothing to be desired

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on this score; but unfortunately the conditions when a shutter is required, or at least when shutter efficiency is important, are almost always those which compel us to use a large stop.

While the efficiency of a shutter is an important matter to the hand-camera user, it is apt to be overrated. The shutter is used in order to get a sharp picture of a rapidly moving object, and what we want is to get as much light action on the plate as we can, coupled with as little sign of movement. Now a very inefficient shutter will cause the exposure to begin and end very gradually, and although this will mean that very little light is reaching the plate at those stages, it is not as bad as it seems, since the light, for part of the time at least, will be too feeble for the movement of the object to show. Put another way, we may say that with an inefficient shutter we can give longer exposures on a moving object without that movement showing than we can with an efficient shutter, but that, on the other hand, the efficient shutter will more fully expose the plate in a shorter time. Efficiency is unquestionably an advantage; but it may not be as great a benefit as it seems in theory. In practice it is very doubtful whether in going from one type of shutter to another, say from the ordinary form of diaphragm shutter to the focal-plane type, any allowance should be made for the supposed increased efficiency of the latter. There may appear to be a great difference between the two; but it is much more likely to be due to inaccurate graduation of one or both than to any perceptible difference in efficiency.

Inaccurate graduation is a very widespread fault in shutters. Some of the best and most expensive instruments are wonderfully accurate, not only when they are new but after a good deal of hard usage. We have known cases in which the shutters were not 5 per cent. in error anywhere throughout the scale after a year's work. When the conditions are considered this is very surprising, and is well within any possible requirements of the photographer. But on the other hand, the great majority of shutters which are graduated at all are graduated incorrectly, not necessarily wilfully. Makers, in some cases, recognize this by declining to guarantee the speeds. Even if the shutter is accurate when it leaves the maker's hands, it may be of such a design that it does not long remain

so. It is chiefly in the highest and lowest graduations that the greatest inaccuracies are to be found, errors as great as 70 per cent. being not at all uncommon. The fact seems to be that, with the cheaper diaphragm shutters especially, the fastest exposures are not often much more than a thirtieth of a second, and this is what they give whether set to $\frac{1}{25}$, $\frac{1}{50}$, or $\frac{1}{100}$ second. Possibly when first made these higher speeds were realized in favourable conditions, but they are not often maintained except in the very best types. The evil is not quite as great as it seems, since these exposures are seldom long enough to give a properly exposed plate. Take, for example, the miscellaneous views, street scenes, architecture, groups, etc., which the tourist so often photographs. With the apparatus he has, fast plates, F/6·5 lens, or something similar, in bright weather, very few indeed of these will be fully exposed with less than a thirtieth of a second, many require twice as long as that. This is about the exposure which is given by most of the non-graduated single-speed shutters on the cheaper hand-cameras, and is about the best all-round speed one can have, although the expert would probably choose a speed of about twice as long if he were limited to one.

The demand for very rapid shutters, except on the part of those who specialize in high-speed work, is one which is largely left to the inexpert. The old hand realizes that it is far more important to get a shutter that will give slow exposures reliably; and, except for special work, would give all the hundredths and thousandths of a second that figure in price lists for a shutter which would give with unfailing accuracy such a series as $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$, $\frac{1}{32}$ second.

The latest developments of the hand-camera have been in the direction of very small folding instruments, which give pictures much less than quarter-plate in size, but which may be enlarged to almost any extent within reason. In order to allow of this, the little camera must be fitted with a high-class lens, must be fairly substantial, must have an arrangement for focussing, and a shutter which can be controlled, or, if not, which gives a comparatively slow exposure; for unless the plate or film has received an ample exposure, it is useless to expect that it can be made to give a good enlargement. Such little instruments may be quite as costly as the larger patterns.

or even more so, and in capable hands are very far from being mere toys. An enlargement 15 × 12 or more from a negative not much larger than a postage stamp is quite within the bounds of possibility ; and when such an enlargement is viewed from the natural distance at which one would view it as a whole, there need be no sign to indicate its tiny origin.

The popularity of the reflex camera has done much to perfect the focal-plane shutter, with which reflex instruments are almost always fitted. The modern focal-plane shutter is set by a turn or two of a knob ; it is controlled by the same or a similar knob working from the outside of the camera, and altering both the tension spring and the width of the slit ; and it gives exposures which are indicated directly upon a dial, and is comparatively smooth and noiseless in its action. Only the more expensive patterns can be relied upon to give the marked exposures with any accuracy, and, what is more important still, to give such slow exposures as an eighth or a sixteenth of a second. The highest speeds are frequently much slower than are given on the dial. The focal-plane shutter has the peculiarity that when the slit is a narrow one different parts of the plate are exposed at different times ; and, as a result, there may be curious distortion in the image, although this is only to be noticed when the object photographed is moving too rapidly for the exposure. An example of this reproduced in some of the illustrated papers has puzzled a good many who were not photographers. It represented a rapidly moving motor-car, and, having been taken with an extremely narrow slit, as this travelled down the plate uncovering first the ground and wheels of the car and then the upper portion, the image of the car moved forward perceptibly, so that the top was exposed some fraction of a second after the lower part, and therefore the whole car seemed to be leaning forward. A dozen times the total exposure given to any one part of the plate may have intervened between the instant at which the bottom and that at which the top was exposed. This distortion is not likely to constitute a drawback in actual work ; if it were to do so it would indicate that the width of the slit should be increased, and the higher speeds got by means of increased tension of the driving springs.

AN ARAB CHIEF
BY W. G. MEREDITH

Although when a camera is being used on a stand a pneumatic or else an "Antinous" release for the shutter is very useful, reducing the chance of shaking the camera, in hand-camera work it is found better not to employ any such device so long as the camera is held in the hand, but to rely upon pressing the button. In doing this, it is important to press it the right way. Next to under-exposure, more negatives are spoilt by shaking the camera when pressing the button than in any other way whatever. The cause of this is that the button is pushed, and in pushing it the whole camera is swung round or moved downwards. Instead of this, the camera should be held in such a way that while the finger on the button tends to push it one way, the other fingers tend to pull it in the opposite direction, so that while the button moves the camera remains steady. This is most important in reflex cameras, since the pressure of the button in most of these has to be continuous and to do a great deal of work, first raising the mirror and then liberating the shutter. On the other hand, the greater weight of the reflex helps to keep it steady.

Most hand-cameras are provided with levels, but they are of little use. When the camera is held in the hand for the hand-camera subjects, it is almost impossible to note the level and the finder at the same time; while if the camera is used for architecture and similar work on a stand, the average hand-camera level is not accurate enough nor sensitive enough to be of much service. There are some people, no doubt, whose sense of the horizontal is so defective that the level as fitted to a hand-camera gives them a valuable indication; but they cannot be very plentiful.

Plate-changing mechanism occupies the premier place in the attention of the hand-camera worker, because the temptation to make exposures is much greater than it is with the stand-camera, and the customary "three double dark slides" prove quite insufficient. Of plate cameras, those are most popular in which the plates are carried vertically in sheaths, with pins or pivots at the end of each sheath on which it swings into a horizontal position at the bottom of the camera when the top of the sheath is released. If such a camera is to be reliable, it must not only be in good

order when bought, but it must be taken great care of. The mechanism is simple and very cheap to make, but it needs gentle usage. The sheaths must not get bent, especially with regard to the pins; the camera must not be exposed to violent shocks, and the position in which it is held during plate-changing is important. As different patterns vary in this respect, it is best to load the sheaths with spoilt negatives first, and to find by trial the angle at which to hold the camera for the changing to be smoothest and most reliable, and, in future always to hold it at that angle when changing a plate.

Plenty of hand-camera workers still use dark slides. They have one great advantage over magazines and magazine cameras, and that is that an accident to the plate-changing mechanism of the latter makes the camera useless; in the former case it is, as a rule, only the one plate in the slide that need suffer if anything goes wrong. If more than one kind of plate is carried, the dark slides allow them to be used in any order that seems to be desirable. Dark slides are bulky compared with magazines; on the other hand, being separate, they stow more easily. A member of the Chinese Legation in London, who was once a popular visitor at many a Photographic Society outing, was famous for the vast number of dark slides which he was able to conceal in different parts of the picturesque Eastern garb which he wore; the exact total was never determined, but he would certainly stand comparison with any magazine camera.

No automatic or magazine changer is absolutely reliable; but some patterns come so near to perfection in that respect that the difference is not worth troubling about. They have already been dealt with in Chapter II. Cut films can be carried in any of the changing arrangements provided for plates. In the case of changing boxes, by means of special sheaths it is often possible to accommodate twice as many cut films as plates. There are also special methods of changing cut films, which cannot be satisfactorily applied to glass plates. The cut film in its most popular form is found in the film pack, already referred to. No plate-changing mechanism, however, can compare in simplicity and reliability with the daylight-loading roll-film cartridge. In using these, although it should be perfectly safe to load the camera in daylight,

it is foolish to do so in any stronger light than is necessary. Nothing is to be gained while there is always the chance that the roll of film may be allowed to uncoil for a moment sufficiently far to let in light and fog it. It is best, therefore, whenever possible, to load the camera indoors; and, if not, at least not in direct sunshine. Some of the very compact cameras close up so closely to the film, that there is a risk when winding off film after exposure that its surface is rubbed against the bellows and marked. To avoid this, the winding off should be done before closing the camera. It is important, too, when using roll film, especially with the modern high-class lenses which have a flat field and a large aperture, to be sure that the surface of the film is as flat as possible, or parts of the picture might be out of focus. To guard against this it is necessary before closing up the camera to make sure that the black paper has been put quite squarely into position and is running true.

The commonest defect of all in hand-camera work is under-exposure. This is due to a great extent to the fact that the user has not learnt how to hold the camera still, or is afraid that if he does not give a very short exposure there will be signs of movement due to his own lack of steadiness. The length of exposure possible depends upon the personal factor (individuals differ very largely in this respect), and upon the constraint or otherwise of the attitude in which the camera is held. The usual plan is to grasp the camera firmly in the two hands, press it against the "lower chest," bend over it to see the image in the finder, and press the button. It is the steadiest method of all, undoubtedly, but has its limitations. The lungs should be deflated and the breath held when the exposure is being made, if possible; but when one cannot be certain to a few seconds when the conditions will be just right for exposing, this is risky, as the moment for pressing the button may find the photographer gasping for breath, and in the worst, rather than the best, possible condition for exposing. The old hand will never lose an opportunity of securing additional support, by leaning against a tree, a wall, or anything that will help to steady the body. It is much better in such circumstances to support the body than to support the camera, unless the latter can be placed on the support free entirely from contact with the person of its

user. Some workers seem to prefer to hold the camera under the right arm while exposing, and get along very well in such a position; but it has always seemed to the author that the attitude is one of constraint, and if the camera has to be held like that for a minute or two, awaiting a favourable opportunity for making the exposure, there is a great risk of movement. Any attitude of tension is to be avoided. A skilful worker has thus summed up the rules for holding the camera:—

1. Hold it in as comfortable a position as possible.
2. Avoid all unnecessary tension on the muscles of the body and legs.
3. Take advantage of any available support for the body.
4. Whenever possible deflate the lungs and hold the breath before exposing.

The actual maximum exposure which can be given without showing signs of movement, the camera being held in the hand, depends on a personal equation. But an eighth of a second should always be possible. The most shaky hand-camera user the author has ever encountered gave an eighth of a second without signs of movement; the author himself has little trouble with exposures of half a second, but this is unusual in his experience. Whatever it be, it is always much longer than the exposure to which most people set their shutters. But in hand-camera work there is not only the movement of the user to consider, but the movement of the subject, and this often imposes very strict limitations on the photograher.

The reflex camera has the great advantage that with it the subject can be arranged on a finder which is correct in all positions and at all distances, which shows the image the full size, and which allows of visual focussing, instead of focussing by scale. Some of these advantages were possessed by the twin-lens camera, which consisted practically of two lenses and cameras, one above the other; the lower camera contained the plate and was fitted with the shutter, the upper one had a focussing screen, and was used as a finder. This type was more bulky and heavy than the reflex (which itself possesses those drawbacks to a considerable extent) and is now obsolete. The reflex is not at all an unsuitable type of instrument for the beginner, but its great advantages over other patterns are found by the more advanced worker. Focussing cannot in actual

A SOUTH COAST QUAY

BY BERTRAM C. WICKISON

practice be carried on up to the moment of exposure, at any rate on a moving object; all that can be done is to anticipate its position in focussing, and then to follow it with the camera, pressing the release when that position is reached and the object is seen to be sharp. The advantages lie chiefly in the degree of accuracy in focussing which is possible with it, which allows us to use large aperture, long focus, and telephoto lenses, which cannot be focussed by scale with sufficient exactness. The reflex, therefore, can be used in a poor light; or in a good light the lens may be fast enough to allow the camera to be held in the hand and a colour screen to be used. On the other hand, we have seen that the type is heavy and bulky; and although flolding reflexes have been made, they are no lighter in consequence, and the saving in bulk is not great. Then the focal-plane shutter which is almost a necessity with them is not very suitable for comparatively slow exposures. The accuracy with which they must be made, and the smoothness of action which is essential where there is so much that must be moved at the moment of exposure, tend to make the type a costly one. So that in this case, as in many others, the advantages of the instrument cannot be obtained without paying for them in more ways than one; and in making a selection these pros and cons must be balanced up, according to the importance each individual attaches to the various features.

Except in the case of the reflex (and the twin lens) all hand-cameras demand that their user shall be a judge of distance. Even those of fixed focus require this, if the wasting of plates on impossible subjects is to be avoided. To estimate distances rapidly is a thing that can soon be learnt by one who makes a serious effort to do so; but the mere using of a hand-camera is not sufficient, and it may take years and grosses of plates if the thing is not set about systematically. Yet too many photographers, as soon as they get a camera, start to try to get results on their plates at once, instead of using a few dozen in learning to master it. An afternoon devoted to judging distance will work wonders. There is no need at first to have the camera. The simplest plan is to go for a walk with a friend and get him to set problems of distances very promptly, and to demand an instant answer. Walking in a wood, let him stop and point to a tree near at hand. Estimate its distance as quickly as

possible, state it, and then measure it off to see how near the estimated is to the actual. It is good practice with trees, it is much better with persons, horses and carts, and such objects; but to be valuable the estimating must be done on a system and not by guesswork, and must be checked with a measure.

The system most workers adopt is one of "lengths." Here we have the standard always with us. A glance on the ground should suffice, with a little practice, to tell us how many times we could lie down head to feet in a straight line from where we stand to the object. Unless the photographer is distinctly diminutive double that number will give the distance in yards accurately enough for our purpose. It is easier to do this quickly than to estimate in yards off-hand. Distances of more than 12 yards need not usually be attempted. There are two other exercises which the hand-camera user will find valuable. One is to select an object, and settle in the mind on a distance, which also should be less than 12 yards. Let him walk briskly towards the object, stop at what is estimated is the predetermined distance, and then check the estimate by measuring. The same method is adopted, by walking neither exactly towards nor away from the object, but on a diagonal line. When walking away from it, as a rule, it is possible to determine the distance merely by counting the paces.

It is not easy to determine the distance of a person moving towards or from the camera, while all the time watching the image in the finder; and in such cases the following plan will be found distinctly helpful, especially to those who photograph groups, street scenes, and single figures. A person of average height, with his hat on, is asked to stand at the distance from the camera at which most work of this character is likely to be done—10 or 12 feet for choice—and then, getting his image in the centre of the finder, a black line is drawn on the finder its exact height, with a fine brush and some Brunswick black. With this line as a guide, it will be found possible to obtain pictures using nothing but the size of the figures as seen in the finder to indicate their distance from the camera.

The original idea of the hand-camera was indicated by its first title, the "detective" camera. It was to be used for the surreptitious photography of individuals. That idea was never realized, though the best use of the camera to-day is for the

photography of persons who are unaware at the time they are in the receipt of adventitious immortality. This puts the subject of "the ethics of hand-camera work" upon the carpet. It has been contended that it is not consistent to condemn the practice of photographing people against their will, and at the same time to give instructions how figures and groups can be photographed without consciousness of the presence of a photographer at work. That the two are not mutually antagonistic will be clear to any one upon reflection; but a dissertation on the subject is out of place in a book such as this. Let it suffice if we say that the hand-camera user who has the instinct of a gentleman will not offend, although he may find what follows of use to him; while the hooligan with or without a camera is a hooligan still, and if our advice helps to make his photographs any better than they would otherwise be, he is probably so much the less objectionable to his victims, although none the less a cad.

The greatest advantage in pictorial photography conferred by the use of hand-camera is that with it we are able to get figures and groups, the models in which are absolutely unconscious that they are being depicted. Their pose, therefore, good or bad, is at least a natural one, the surroundings may be the real thing, and in perfect keeping, and there is none of that suggestion that the whole arrangement has been made up to be photographed, which in other methods is only avoided with great difficulty. Mr. Craig Annan, and there could hardly be a higher authority on the subject, has said that the pictorial worker should no more have to worry about his tools and methods than the writer needs to think of his pen while using it; and although photography has not yet reached to that stage, the hand-camera has taken it appreciably nearer.

In work of this kind a long-focus lens becomes very valuable, not only because it allows us to be further from the figures and so to get them all of full size with the better drawing given by the more distant standpoint, but also because there is less likelihood of attracting their attention and so rendering them camera-conscious. For this kind of work the reflex camera with one of the moderate power fixed mount telephoto lenses which have been introduced of late years (see page 77) will be found more suitable than any other. The focussing has to

be carried out much more carefully, and the camera held as steadily as possible, but such work is thoroughly practicable. It is important, however, to fit the telephoto lens, temporarily or permanently, with a much longer hood than that with which the maker supplies it, if the results are to be clear and bright; as a general rule such a hood, if of the diameter of the maker's hood, may extend at least as far in front of the lens as the back of the lens is from the plate, without any fear of cutting off any of the image.

It is as a travel or holiday companion that the hand-camera finds its most general use; and what could be better in that capacity than a compact, often a pocket, instrument, which, with a little skill, will bring back to us at a moment's notice scenes we may never be able to revisit, and incidents that may never recur? The tourist will want to use his camera not only for figures and groups, but for architecture, shipping, street scenes, landscape, and all the miscellaneous purposes to which any kind of camera can be put. Architecture is perhaps that to which it is least fitted, yet it can be used to give successful results. The great virtue of an architectural subject to a hand-camera worker is that it will keep still just as long as he cares to take in photographing it.

It is in applying it to architecture that the photographer first learns the importance of the rising front. In all probability he will find, if his camera has not got a rising front, that he gets a great deal more of the ground on his plate than he wants, while the skyline of the building goes right out of the top of the picture. With a rising front this may be curable, though it does not follow. Many cameras have a maximum rise of one inch on a quarter-plate, and though this is much better than nothing, there are often occasions when more would be a distinct convenience. A few hand-cameras have a swing back, but this is not common, and if neither rising front nor swing back are provided it is a question of tipping the camera or of leaving the subject unphotographed or incomplete. There is quite an unnecessary objection to tipping the camera. The practice is not one to be indulged in when it can be prevented; but if there is no other way of getting what we want upon the plate, there is no conceivable reason why the camera should not be tipped. Of course negatives so made cannot be printed

by contact, or they will show vertical lines converging at the top of the picture, but by properly swinging the plate and the easel when enlarging or making lantern slides this can be corrected with surprisingly little trouble.

The problem of exposure which confronts every camera user is complicated in hand-camera work by the fact that not only must the exposure be the correct one as required by the plate, but it must be brief enough for the negative to show no signs of movement, either of the camera or the subject. Tables are given in some of the books showing how short the exposure must be to secure sharpness with different classes of subjects—express trains so much, jumping horses so much, etc., etc. Such tables are worse than useless; they are misleading. If they do give the exposure which will prevent movement from showing, which as a rule they do not, it is so short as to be impracticable with most cameras, and far shorter than should be necessary in most cases. In addition to this the figures are or should be given for a specific size of the image on the plate and for motion at some given angle to the axis of the camera—conditions which the photographer finds it difficult to observe. The best rule with rapidly moving objects is to ascertain the shortest possible exposure that will give a correctly exposed plate with the largest lens aperture, and to give that exposure. If the negative is a good one, well and good; if it is not, the photographer has the satisfaction, such as it is, of knowing that he did his best. In all rapidly moving objects the camera should be as near their path as possible, so as to get an almost front view. This reduces any blurring due to movement to a great extent, and apart from that is nearly always a much more agreeable arrangement than when the moving object is taken broadside on. It is possible in this way to get jumping horses, express trains, and similar subjects quite sharp, to all appearances, with the ordinary hand-camera shutter, graduated to a one-hundreth of a second and actually working, perhaps, at a fortieth. But the moving objects should be as small on the plate as is possible, as the smaller they are the smaller is the apparent blurring caused by movement.

Exposures made from boats and other moving supports, require to be short to prevent movement of the camera from showing. On the other hand, they are very rarely made on

rapidly moving objects near at hand, so that the exposure may be longer than in the previously considered case. We are also working, practically, with a fixed-focus camera, for we can set it to infinity and leave it there, since we are hardly likely to have any part of the subject near enough for special focussing to be necessary. There is another advantage in such subjects, and that is that there is very seldom need for a short exposure on account of the plate, the subjects usually being well lit, or at least without heavy foreground shadows.

In photographing from a steamer there is often more trouble from the vibration caused by the engines than from the progression of the vessel. To minimize this, the hand-camera should be held in the hand rather than planted on the taffrail, the body then deadens the shock. As a general rule, it will be found that a twenty-fifth or thirty-second of a second is ample for all exposures made from a moving ship with a hand-camera with a 5-inch or 6-inch lens. Exposures from small boats are in a different category, and must be determined by the particular conditions prevailing. If any sea is on, the movement of the boat is much more rapid, while at the same time the surface of the water is much nearer, is on a bigger scale on the plate, and, therefore, any movement is magnified.

It is in street scenes and groups that the trouble of harmonizing the demands of the plate for a long exposure and of the subject for a short one is likely to be greatest. Here we have moving objects comparatively near the camera, and deep shadows at no great distance. It is in work of this character that the advantages of a high-class modern-type lens and of a reflector camera shine forth; but a great deal can be done with quite inexpensive apparatus if the conditions are not unfavourable. Assuming, as before, that the camera is a quarter-plate one, with a lens of about 5 inches focus and working at F/8, a fiftieth of a second will be found to be what such subjects require, if they are to be taken haphazard and are to show no movement with figures walking 10 or 12 yards from the camera. In very many cases this would mean that the plate was hopelessly under-exposed. But there is no need to work haphazard, and much longer exposures can be given if the subject is studied a little. With such movements as that of a man's legs when he is walking—and this is the most

troublesome movement of all to the hand-camera user—there is a stage when they are moving much faster than the average movement of the man, and another when they are almost motionless. It is this second stage which impresses itself most strongly on the eye; and painters, therefore, when drawing a man walking, draw him in one of these positions when his movement is least perceptible. Such poses are now the accepted conventional methods of representing figures walking, and fortunately for the hand-camera user they are the easiest with which he can deal. He should learn, therefore, to recognize them, and to time his exposure so that if there is a walking figure in the picture on a large scale, it is photographed when its movement is at a minimum. It is the neglect of such opportunities, coupled with the use of a very short exposure, made necessary by such neglect, that we owe the snapshots of street scenes that are so commonly seen, the figures in which are almost comically unnatural in their attitudes. There may be a scientific use for such photographs, but pictorially they are to be condemned. Under the conditions just named, instead of the fiftieth of a second, which is the minimum for haphazard exposures, a sixteenth of a second will be ample if the moment of exposure is selected judiciously. Vehicles in motion in street scenes are to be avoided unless they are quite at a distance, as otherwise the exposure has to be cut down to such a point as to mean certain under-exposure for the plate.

There are many subjects with which the focal-plane or else the "Multi-speed" shutter alone can deal satisfactorily. These include such photographic *tours de force* as motor-cars and express trains, broadside on and in full flight, divers in mid-air, skipping scenes with every strand in the whirling rope distinctly visible. For work of this character not only is an extremely rapid shutter necessary, but the lighting must be exceptionally good, the lens used at a large opening, and, as a rule, the camera must be of the reflector type. They are curious rather than beautiful, and, as in the case of wave subjects, pictorial effect is lost entirely by the absence of all suggestion of movement. A train just starting from a station, with the column of steam and smoke shot upwards by its efforts, taken with an exposure of, say, a thirty-second of a

second, looks far more as if it were moving than the same train crisply defined in every part, though travelling at twenty times the speed and "snapped" in the thousandth of a second.

The hand-camera, so far, has been considered throughout as if the exposures with it were always controllable and known; but this is only the case in exceptional circumstances. There are many, probably the majority, which have shutters of one fixed speed. It must not be supposed that they dispense with the necessity for taking any account of exposures. Far from it. Unless the user of such a camera takes a little trouble to ascertain what are the requirements of his plate on the one hand, and of his subjects on the other, he will find that his waste of plates is enormous, and that a successful result is only an occasional accident. The lesson he must learn is, what is and what is not, possible with his camera. The shutters of such instruments generally give exposures from one-twentieth to one-fiftieth of a second. This, as can be seen from what has already been said, is, perhaps, the best average speed to possess, and if the lens is one which is reasonably rapid, say F/8, a great deal of good work can be done with a such a tool. Single-speed shutters are fitted, as a rule, on cameras with a single lens, which seldom work at a larger opening than F/11, and this lessens the possibilities somewhat. Street scenes are only practicable, then, if the street is fairly open and the light good. Given these conditions, the results with a cheap camera of this type may be as good as, or even better than, those obtained with a more costly apparatus, if this latter is in the hands of one who is not able to take full advantage of its good points. Landscapes generally, except woodland scenery under trees and shut in, façades of buildings, shipping, figures in the open, are all dealt with very easily with a camera with a single lens and a single-speed shutter. But it cannot be used successfully when the light is poor, such as on most winter days in this country—except for snow scenes—or when the sun is low on the horizon, or for figure subjects with heavy shadows, such as are to be met with in the narrow, picturesque streets of South Europe, or for figures under cover. The great thing with such a camera is to study its limitations, and to be prepared for disappointment if they are overstepped.

HONESTY

BY JOHN M. WHITEHEAD

There are many people who carry a camera but have never done any of the photographic work themselves. Nothing can be said against such a practice except that it is not photography, and is very wasteful of money. Because even if the work is distasteful and irksome, and therefore delegated to some one else, it is not possible to secure a reasonable percentage of good results, unless the user, or perhaps we ought to say the wearer, of the camera has been through the mill of development and printing, and has got an understanding of what he is doing when he "presses the button," an understanding which he can acquire in no other way. If hand-camera work is to be anything more than a series of bitter disappointments, broken only by unseemly joy over the one poor plate that mars the otherwise even monotony of the ninety-nine that are so negative as not to be negatives at all, a little time must be spent in learning to use the camera properly, and development and printing must be practised even if they are afterwards to be abandoned to others.

There is a large and growing class, however, who regard hand-camera work as something more than irresponsible snap-shotting; who expect to get good negatives from the great majority of the plates which they expose; who no more regard it as mere "button-pressing" than successful shooting is mere trigger-pulling. To them the hand-camera is not a degenerate stand-camera become a toy, but the highest stage which the evolution of photographic apparatus has reached, an instrument of precision, the results with which are as certainly successful as with any other well-made apparatus in the hands of fallible humanity.

CHAPTER XIV

THE PRINT

P. O. P.—Sensitiveness—Most suitable negatives—Vignetting—Washing and toning—Separate or combined baths—Self-toning papers—Double tones—Developing partially printed P.O.P.—Platinum toning—Fixing—Washers—Squeegeeing—Mounting—Dry mounting.

THE negative is only a means to an end, that end in almost every case is the print. There must be just one small reservation, because in certain branches of scientific photography the need for extreme accuracy in the dimensions of the photograph compels the use of the negative as the final result, the expansion and contraction of a paper print with varying degrees of humidity of the atmosphere putting its use quite out of the question.

Amateur photographers, with this trifling exception, regard the print as the final result, a statement which holds good, whether the print is a contact one on a slow paper, a direct enlargement on bromide paper, or a print on glass in the shape of a lantern slide. For the majority, too, a print is a print on some more or less shiny surfaced "silver" paper, the universally used "Printing Out Paper," or P.O.P. P.O.P. is a comparatively recent introduction. Like "gaslight" paper, manufacturers knew how to make it long before they put it on the market in any quantity, and it was due to the enterprise of Ilford, Ltd., that the demand for it was created, at the expense of the trade in albumenized paper, which was virtually killed in the process.

In "P.O.P." the sensitive silver salt is applied to the paper either in gelatine or in collodion. The latter is more popular abroad than in Great Britain. In order that P.O.P. may be sufficiently sensitive to be usable at all, and give a rich image by

printing out, it is not sufficient that it should contain silver chloride only. This is an insoluble salt, and although it does not keep in gelatine as well as does silver bromide, still it is fairly stable. But, unfortunately for the P.O.P. process, soluble salts of silver of a much less permanent character have to be present in the coating, with the result that most forms of P.O.P. gradually, but inevitably, discolour and spoil, even if kept in the dark and with every possible protection. We are speaking now of the keeping properties of the paper in its sensitive condition, not of the permanence of the prints, which will be considered later. The presence of these silver compounds makes it important that P.O.P. should be used while it is still comparatively fresh; and as its deterioration is accelerated by heat, by impure air, and by emanations from common cardboard and other materials of a like kind, it is important that it should be well packed and stored in a cool place, free from gas fumes and the products of combustion generally. Latterly there have been brands of P.O.P. on the market which are said to be free from such silver compounds, and therefore keep in good working order for a long while.

The different grades and colours of the paper suit it for different purposes. The mauve or rose tinted glossy papers are liked by many for such portrait work as appeals to the philistine Briton. A slightly higher taste prefers the white; but it does not need a very great degree of culture for all glossy surfaces of the P.O.P. type to be distasteful, and a matt paper, white for choice, to be preferred. There are different degrees of "matt" paper on the market, and generally speaking, the smoother paper is suitable for the smaller sizes. The custom of supplying the paper in pieces cut to the size of the negative rather than in full size sheets, which is now very wide spread, is economical, even from the point of view of those who use only a part of their negative, as it enables the paper to be packed flat in compact envelopes, and saves risk of damage from finger marks when the paper is being cut up; for P.O.P. is very easily injured. The surface is readily absorbent, and a warm finger pressed on it, or the slightest dampness, may make a mark which will be visible on the finished print.

The sensitiveness of P.O.P. is such that it can be freely handled in an ordinary room lit with daylight; but, of course,

even then it must not be exposed too long or there will be a risk of degradation of the whites. There is a method of developing a print on P.O.P., which has only had a short exposure to light, by means of which a strong rich print can be obtained very quickly. As this method brings out very slight traces of light action, traces which in the ordinary way would be quite invisible, it follows that paper that is to be developed must on no account be exposed to daylight with the freedom that may be used if the paper is to be printed out. P.O.P. is coated in yellow light, and if the prints are to be developed the packet should be opened and the printing frame filled and emptied in yellow light also.

It is generally supposed that a very soft negative is required for P.O.P., but this may easily mislead. Soft it must certainly be compared with the negative that is to give a print in carbon or in platinum, but one distinctly harder than will give the best bromide enlargement or print on "gaslight" paper is needed. Much can be done by printing in a light to suit the negative. Thus a strong negative is best printed in a strong light—anything short of sunlight, as this tends to lessen contrast in the print. A weak negative in the same way gives a stronger print if the printing is done slowly in a weak light. The printing frames in these two cases need not be separated, but that containing the strong negative exposed to the direct light of the sky, while the frame with the thin one has one or two thicknesses of tissue paper pasted across it to moderate the light. A curious increase in the contrast of the print, which has never been satisfactorily explained, will be found if the printing is conducted with a piece of green glass between the negative and the light. Direct sunshine is to be avoided in all printing operations, as unless the negative is very fogged or over-exposed the printing is unmanageably quick, and every speck or blemish in the glass of the negative, and very little glass is quite free from blemish, is faithfully copied in the print by the parallel rays of sunshine. In diffused light such spots are vignetted as it were, and do not appear.

Mention of vignetting raises the question how far the photographic "vignette" is justifiable, pictorially. It was Dr. Emerson who first showed that it was a mere commercial "dodge," borrowed from another art without borrowing its

justification. In a chalk drawing the artist may leave the background untouched, that he may concentrate his attention and work on the head; in photography the printer who vignettes takes trouble to imitate a style the excuse for which is that it saves labour. A delicately lit head vignetted against a background of white paper is repulsive, from the falsification of its tones, and such things are permissible only in commercial work to suit an uncultivated taste, or rather a lack of taste altogether. If "vignetted heads," as they are called in price lists, are not allowable pictorially, there are cases where a vignette effect is not to be condemned. In little prints which are often used to decorate such things as menus, programmes, and initial letters, a skilful vignetting may be more satisfactory than plain masking. But such vignetting is impossible with the "vignetting shapes" of commerce, and demands individual treatment. The size and shape of the vignette must first be settled, and then cut out in a sheet of cardboard, which is fastened over the face of the printing frame, half an inch or so from the negative. It may be that it is possible to print the vignette straight away with this device, but it will often be found impracticable without pasting a piece of tissue paper over the card to diffuse the light. For the same purpose the outline of the card is not cut with a smooth edge, but it is jagged with teeth like a saw. When there are light parts on the negative which lie beyond the boundaries of the vignette, it may be found that these will show on the print, from the diffused light getting round the edges of the opening in the card. In such a case, after fixing the card in position, cotton wool may be pushed through the opening so as to block up the space between the negative and the card, while by teazing out its edges anything like a hard line can be prevented.

The gelatine film of a negative has a strong affinity for moisture. If printing is conducted in a damp atmosphere, therefore, there is a very great risk of the negative absorbing moisture through the paper on which the print is being made. As in the case of P.O.P., this paper contains soluble salts of silver; some of these are transferred to the negative with the moisture, and under the influence of the light they rapidly turn into black spots, which, as they consist of metallic silver, as does the picture in the negative itself, are very difficult of

removal without the image on the negative also being affected. In bad cases, such as may happen when a shower of rain comes on while printing frames are out, the paper may stick to the negative. Leaving the paper in the frame over night, in damp weather, is a very fertile source of these spots, as also is printing before the negative is quite dry. There is no remedy that is invariably efficacious, but the best is the following:—

If the paper has stuck to the negative, as much of the paper as can be removed while it is dry is pulled off, and then the negative is placed for an hour or so in a freshly mixed hypo bath of three or four ounces to the pint. At the end of this time, a little gentle rubbing with the finger will remove anything adhering to the film, and if the photographer has been very fortunate, he may find that the negative is not marked in any way. If it is spotted at all, it must then be washed for a few minutes, and placed in a combined toning and fixing bath, which will remove the spots in an hour or two, if they are to be removed at all. If the negative is only spotted, the preliminary hypo bath may be omitted. If the combined bath does not remove the spots in a couple of hours the case is hopeless.

Varnishing a negative lessens very much the risk of it getting spotted by being printed in a damp condition; but contrary to the belief of many photographers, it does not remove the risk entirely, and if a varnished negative does get spotted, there is much less likelihood of removing the spots. The best preventive is to make sure that the film of the negative is dry before it is printed, to see that the pad at the back of the printing frame is dry also, and not to leave the print in the frame all night. By interposing a piece of sheet rubber between the back of the print and the back of the frame, as is invariably done when printing in platinum, an additional precaution against damp is taken.

As there are many different brands of P.O.P. on the market, which differ amongst themselves in the composition of the sensitive coating, and in the details of the subsequent treatment, there would be little or no advantage in describing a method which would be applicable to all, yet probably not that which is best suited to any one of them. Every packet of P.O.P. contains a description of the treatment which the maker regards as most suitable for his paper, and this, unless

THE POOL

BY R. B. PENMAN

the photographer thinks he knows better, is what should be followed.

Albumenized paper is practically obsolete. Gelatino-chloride paper, such as is the great majority of P.O.P. on the market, must only be dealt with at ordinary temperatures. If the solutions are at all warm, or if the prints are transferred from one bath to another at a distinctly different temperature, there is a great risk of the film blistering; while in hot weather, or even with the heat of the fingers, if the print has been long wet, the film may melt. With collodion P.O.P. there is not this risk, as the film is quite insoluble in water, hot or cold.

The depth to which printing must be carried varies very greatly with different brands of paper, and varies also with the treatment to which the paper is subsequently to be exposed, in the shape of toning. So great is this variation that, beyond pointing out that as a rule the print looks a little colder in shade and darker in tone when dry than when wet, no generalities can be of much use.

Very few of those who take up printing on P.O.P. realize at first the importance of thoroughly washing the prints before attempting to tone them. The soluble silver salts which the film on the paper contains must be removed, if waste of the gold in the toning bath is to be prevented, and the toning is to be even and successful. It is not sufficient in this preliminary washing, or indeed in any operation to which the prints are to be subjected, to let them lie in the dish in a mass. They must be separated and kept moving. The simplest and easiest method is to place them one by one in the dish of water, letting each one get limp before putting the next on the top of it. The pile of prints is then turned over, and taking the print first immersed, it is held up a moment to drain and then placed in a dish of clean water. Each print is transferred in the same way, and then the pile is again turned over, and the operation repeated. Five or six changes of water should be given, until there is not the least cloudiness in the drainings from the prints. If soft water is used the drainings should be allowed to drop into a glass containing some water, to which has been added a pinch of common salt, and there should be no cloudiness where the water from the print meets the salt solution.

Gold toning may be carried out in three distinct methods. A toning bath may be applied to the print, which is afterwards washed and fixed in a separate solution. Or a bath which both tones and fixes the print may be used. Or the paper may contain the materials for toning the picture, and need only immersion in plain water, or at least in some solution which does not contain gold, to yield a toned print.

The first of these three methods is, beyond question, the best. Not only is the range of possible tones much wider, but the action is better understood, and the results, if it has been properly carried out, are more likely to be permanent. The combined toning and fixing bath is convenient; but it labours under the disadvantage that it will tone when the gold is exhausted, so that it is not easy to know whether the print is or is not being toned with gold; and in the latter case there are considerable doubts as to the permanence of the final result. The range of tones in the "self-toning" papers is limited; but they appeal to many who do not care to be troubled to make up different solutions.

The commonest defect in gold-toned P.O.P. prints, is known as "double toning." It is due to the complete toning of the lighter parts of the print before the bath has had any appreciable action on the deeper shadows. While the high lights, therefore, are bluish in shade, the shadows are warm, often quite red. The cause lies in the use of a toning bath too strong altogether, and therefore too rapid in its action, or one which contains too large a proportion of sulphocyanide. Another possible cause of double toning is the use of a toning bath exhausted of its gold either by excessive use or from the presence of some impurity which has precipitated all the gold in the form of a black sediment. Double toning is rarely to be met with in prints toned in baths which do not contain sulphocyanide, but there is no need to avoid that salt on account of it if it is used in a proportion suitable to the rest of the bath. It is said that combined toning and fixing baths never produce double tones. They may, however, tone a print before the fixing action is complete; and thus lead to the finished print being imperfectly fixed. The only guarantee against this is the use of a separate fixing bath afterwards, which sacrifices all the supposed advantages of the combined bath.

THE ORCHARD

BY CLARENCE WHITE

It is possible to curtail the exposure required to obtain a printed out print on P.O.P. to one-hundredth of the total time, or even less, by developing the print. There are two methods of doing this. In one the developer used is an acid one, and the dry print is placed direct into it, developed to the required extent, and then toned and fixed. In the other the print is immersed in a "bromizing" solution; this is nothing more than a 10 per cent. solution of potassium bromide, and after five or ten minutes is washed and developed.

The chief trouble about the first of these development processes, is that there is a great likelihood that the print will be stained; in fact the back of the print is almost inevitably discoloured, and the action often shows right through. An acid developer that is suitable is the following:—

Hydrokinone	16 grs.
Citric acid	40 grs.
Sodium acetate	1 oz.
Water	20 ozs.

The second method was introduced by the Paget Prize Plate Company, and is a perfectly practical process. The partially printed photographs, on which the image may be only barely visible, are immersed in 10 per cent. potassium bromide solution, which converts the soluble salts of silver in the paper into silver bromide, and prevents them from staining it. Then, after washing two or three minutes in running water the prints are placed in the developer, in which they come up to their full vigour in from three to eight minutes, according to circumstances. The developer is made up of two stock solutions as follows:—

A.	Hydrokinone	2 grs
	Sodium sulphite	8 grs.
	Water to make	1 oz.
B.	Potassium bromide	55 grs.
	Sodium carbonate (crystals)	44 grs.
	Water to make	1 oz.

The proportions in which these two solutions are used may be varied. When the negative is a very flat one, and as much

contrast as possible is wanted in the print, we may use 3 drs. of A diluted to 1 oz. with water and mixed with an ounce of B. If, on the other hand, the negative is hard and we want to lessen contrast, we may use more of A up to as much as 7 drs., diluting it to make 1 oz., and then adding an ounce of B as before. However much or little of A is employed, it must be made up to an ounce with water, the quantity of B being left unaltered. A medium developer would contain ½ oz. of A. On taking the print out of the developer, it must be washed for a moment and then placed in 10 per cent. bromide again for a minute or two, after which it can be well washed and toned and fixed in exactly the same manner as if it had been printed right out. P.O.P. which is to be developed in this way must be handled in a much weaker light than if it is to be printed out. Any ordinary artificial light may be used, both for filling the frames and for developing the prints, but daylight, unless it is very weak indeed, must be avoided.

Hitherto gold-toning only has been considered; but the photographer is not limited to salts of gold for the purpose. Very fine tones on P.O.P. can be obtained by toning with platinum, and another fine series by toning first with gold, taking care not to carry the operation too far, and then with platinum. The platinum salt that is most generally used for this purpose is potassium chloroplatinite.

Whether the print be toned with platinum or with gold it is important that it should be washed between toning and fixing. In the case of gold-toning, in order to stop the action as soon as the right stage is reached, some workers put the print in a weak solution of common salt, washing it slightly afterwards before fixing. There is likelihood of discolouration if a print containing in its pores some of the toning solution is put straight into the hypo. It is still more important in the case of platinum toning, since the toning solution is acid, and the introduction of acid into the hypo bath is always detrimental.

Self-toning papers vary in the treatment prescribed for them even more than the others. Some of them tone in plain water, others need sulphocyanide or other baths. They all have a strong tendency to give very warm colours, whatever the treatment adopted, except when the print is separately

toned with platinum. Some of the best self-toning papers are made with collodion instead of gelatine as the vehicle; and with these very fine sepia tones can be got by means of a platinum bath, and good brown and purple tones by plain fixing.

After fixing, and it is well to remember that complete fixing is as important as thorough washing, the hypo and the silver it has dissolved from the coating on the paper must be washed out. There are washers innumerable on the market for this purpose, but they vary very much in their efficiency, and if one of them is used reliance should only be placed upon it after it has been tested. For this purpose, after a number of prints have been washed in it for the time which is supposed to be sufficient, the prints should be allowed to drain as thoroughly as possible into clean glasses, and to the drainings of each a little water faintly coloured with potassium permanganate should be added. If the colour is discharged or changed to a pale yellow, the washing has not been thorough. It is necessary to test all the prints of any one bath, as some from the accident of floating loose may be completely washed, while others which have been close together still contain hypo. It is this clinging together which is the great difficulty the designers of print washers have to overcome. In some instruments each print is held apart from its neighbours, and the trouble is overcome though in rather an elaborate manner. In others, reliance is placed upon the inrush of the water to keep the prints apart, and this may or may not be effective, depending upon the extent to which the user carries out the intention of the designer of the washer.

When a few prints only are to be washed, there is nothing quite so efficacious and so economical of water as transferring them one by one from one dish to another with thorough draining in between, the water in each dish being changed and the dish rinsed out between each transference. Or the prints may be washed individually very quickly. MM. Lumiere showed, some years ago, that the washing of P.O.P. prints would be made much more speedy and efficacious, if the prints between each change were put in a mass and as much water as possible squeegeed out of them. Those who use "hypo-eliminators" for negatives may care to do so also for their

prints, and permanganate used in the way already described is said to be effective. But plain water and frequent changes are best, provided the prints are kept moving separately. The one way in which they cannot be washed is by allowing them to accumulate in a mass and leaving them so.

When the prints are fully washed they have to be dried, and if the surface is one of gelatine, they should not be dried in contact with anything to which they may stick. The best plan after draining them is to spread them face upwards on a clean towel. Blotting-paper is sometimes recommended, but it must be that specially made for photographic purposes, as common blotting-paper contains a great deal of hypo. Moreover the paper soon perishes. No heat should be used for gelatino-chloride P.O.P., unless it has been thoroughly hardened with formaline, and even then it is not advantageous, though permissible if the prints are wanted in a hurry. Collodio-chloride P.O.P. may be dried by heat if it is thought desirable.

A great many photographers are in the habit of squeegeeing their prints face downwards on to some material, but it is certainly better to allow them to dry first, and then to rewet them to squeegee. If this is done there will be no risk of the prints sticking to the surface employed and tearing. The squeegeeing process allows of a great range of surface, from an extremely high gloss to a coarse matt.

The highest gloss of all is obtained by the process miscalled "enamelling." A sheet of plate-glass is well polished with French chalk, coated with enamel collodion, and immersed in a weak warm solution of gelatine. In this the print, which must have been hardened in alum or formalin if it is on gelatino-chloride paper, is brought face downwards on to the collodionized surface, and being removed from the liquid is squeegeed into contact all over and dried. When dry the print can be stripped off without any trouble, and has as brilliantly smooth a surface as that of the glass itself. This method is very little used now, as it is possible to get almost the same effect by simple squeegeeing.

The highest gloss is that given by glass, but there is a greater chance of the print adhering. The glass should have a cream of beeswax and turpentine, or one of the ready-made preparations sold for the purpose, smeared over its

surface, as much as possible should be wiped off, and then the glass polished with a cloth that is free from fluff. An almost equally good surface can be obtained by using "ferrotype" plates, a kind of japanned iron; pulp boards are sold for the same purpose. Celluloid also answers well. All these, except the glass, may be used without the preliminary waxing, and in the case of celluloid this should not be attempted. With ferrotype or pulp boards, it is well to wax them occasionally, as the washing tends to remove the slight greasiness which is otherwise their natural surface. Instead of wax, some photographers treat the glass with French chalk, but this should only be used for glossy and not for matt surfaces. A little is scattered on the surface, and then polished over and rubbed off by going over the glass with a clean cloth; but the polishing must be done gently or the chalk will be rubbed into it too much. Glass has this advantage over the ferrotype, that it is transparent, and, therefore, by looking at the back, it is possible to see if the squeegeeing has been done effectively, or if there are any air-bells left. A sheet of thin rubber or of American cloth should be placed between the back of the print and the squeegee; a flat squeegee is better than one of the roller pattern for this purpose. By the use of finely ground glass or celluloid, glossy P.O.P. may be given a matt surface of a very agreeable character and quite different from the natural matt of the matt papers.

The one difficulty likely to be encountered in squeegeeing is the sticking of the print to the drying surface, whatever it may be. If the print is not thoroughly dry it is certain to stick, and any attempt to remove it will ruin it irretrievably. If the weather is warm, it is possible that the gelatine surface of the print has begun to decompose, and this will make it stick. Formaline or alum is the preventive in such a case—there is no remedy. If the glass or ferrotype is not properly clean, the print may stick. After each batch of prints has been dried, the squeegeeing surface should be well washed with a soft rag and soap and water, thoroughly rinsed and put up to dry. If the mounting method described in the next paragraph has been used, the glass or what not should be soaked for half an hour in cold water, and then washed with warm water and soap. When one is sure that the prints are

perfectly dry, they may be held an instant before a bright fire or in direct sunshine, and this should be sufficient to bring them off. Otherwise one corner may be raised and the print stripped off, by pulling it gently away from the plate, and not by rolling it back, as a sharp curve would break the surface.

One of the most convenient methods of mounting P.O.P. prints was one which the author saw in use at the Eastman Kodak works in Rochester, U.S.A., some years ago. The prints, as soon as they were dry on the ferrotype sheets, but not before, were brushed all over on the back with a glue made by soaking ordinary white gelatine in water, and then dissolving it by heat and applying it hot. This also was allowed to get thoroughly dry, and then the print was stripped off, and trimmed. If it were not to be mounted, the gelatine coating helped to keep it flat; while if it were to be mounted, all that was necessary was to damp a mount with a sponge, place the dry print upon it in position, and pass the two together through a rolling press—a domestic wringer would do quite well. The print came out mounted flat, and without that loss of gloss which follows most mounting methods when the print itself becomes moist.

Trimming is best deferred until the print is quite finished. There are several reasons for this course. It is convenient to be able to trim deliberately in a good light, trying the effect of different shapes and sizes until one best suited to the subject is reached. This can be done by using two pieces of card cut to the shape of an L, and sliding them over each other on the print so as to enclose a rectangular space. By deferring trimming, the extreme corners of the prints, which must inevitably get handled in the processes, are cut off, and the edges which hardly ever are toned quite evenly with the rest of the print are removed.

Trimming is a process all prints, more or less, must undergo; but it is perhaps most conveniently considered here. Prints must be quite dry before they are trimmed or they are sure to tear. The same result follows when we attempt to trim a print with a blunt knife. All sorts of knives are used for the purpose, but there is nothing better than the ordinary pocket knife, with its point kept as sharp as possible by frequent application of a

little piece of Washita or other suitable oilstone, which can be got at any tool shop. Most photographic hand-books recommend trimming prints on a sheet of glass, and with a glass-cutting shape. The glass is a nice surface on which to cut, but it punishes the knife-point terribly, and a piece of smooth card or linoleum is much better, though this too will soon blunt the knife if it is dug down needlessly deep into it. The card also gives a better grip to the print and prevents the cutting-guide from slipping.

Glass cutting shapes are a delusion and a snare. Some little time ago the author, requiring a whole-plate shape, went right through a dealer's large stock without finding a single one which was reasonably accurate, and the fault lies not so much with the maker as with the material, which, except at great expense, does not lend itself to accuracy of this kind. It is much better to cut with a steel straight-edge and to use a draughtsman's triangle of celluloid or wood by which to get the corners true.

At the risk of being accused of teaching one's grandmother to suck eggs, a few words on the use of these instruments may be given. Assuming that we have a print to trim, let us note the stages of the operation. The first thing to do is to settle approximately with a cardboard L the boundaries which the trimmed print is to possess. These are not to be marked on the centre of the print, as we may find it necessary just to include a part we should have marked, but a pencil mark is made where each proposed edge cuts the present edge of the print.

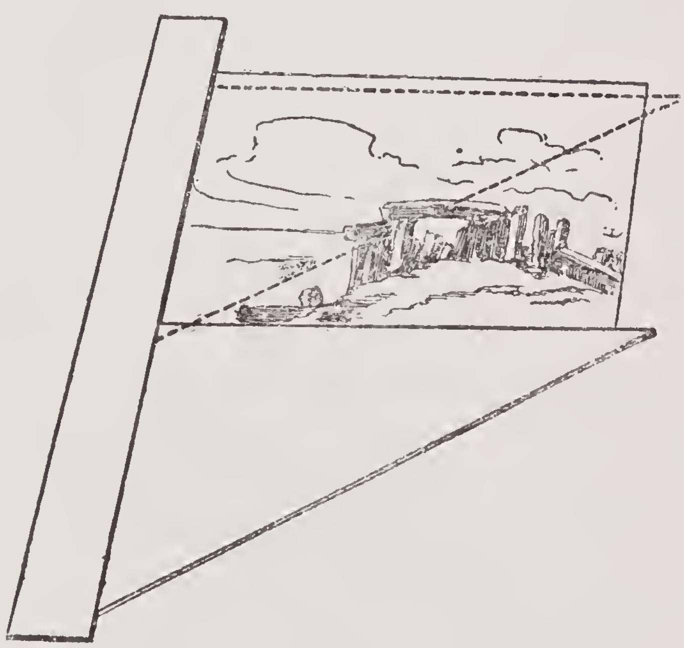

Fig. 15.

The square is then placed, as shown by the dotted lines in Fig. 15, with one of the sides which form the right angle parallel with a prominent horizontal or vertical line in the print, a vertical line for choice in architectural subjects, the horizon in sea scenes. Against this same side is placed

the straight-edge, and then holding the straight-edge firmly, the triangle is slid along it, until the side at right angles to the straight-edge reaches the mark at the edge of the print. The triangle is then held firmly in its turn, and the straight-edge is placed along its other side, when, the triangle being removed, the first cut is made. In this way we can be certain that the edge of the print is parallel with the horizon or with the vertical lines of the buildings, as the case may be. Those who are not accustomed to this kind of work may find it safer, instead of cutting the print at this stage, to rule a line with a sharply pointed pencil. The triangle is then slid along the straight-edge until it reaches the second boundary of the print, the straight-edge is put along its other edge, and the second line ruled or cut, and so on with the other two. It ought to be done with sufficient care that when the fourth side has been done, the angle it makes with the first, tested by applying the triangle, reveals no perceptible inaccuracy whatever.

One method of mounting has already been described. The purity of the mountant employed has a very great influence on the permanence of a print on P.O.P. Ordinary glue, which is most impure, should never be used, but the white gelatine, such as Heinrich's or Nelson's, will answer. Nelson's "X Opaque" or cooking gelatine is suitable for mounting.

A gelatine mountant may be made with spirit, which has this advantage, that it does not interfere so much with the gloss of the surface as a water mountant. Such a preparation is made by soaking an ounce and a half of gelatine in half a pint of water until it is quite soft, and then placing the vessel containing it in hot water until the whole is liquid. A mixture of five ounces of spirit of wine—methylated spirit can be used, but is not so suitable—and an ounce of glycerine is then stirred in. Too much spirit will precipitate the gelatine. This mountant should be put away in wide-mouth corked bottles, and will keep for a long time, keeping all the better if five grains of thymol are dissolved in the spirit. To use it, the bottle is placed in warm water for a few minutes, and then in hot water, and the mountant, which will then be liquid, is brushed over the back of the print.

Another mountant is made by diluting the rubber solution

PLAYTIME

BY WILL CADBY

sold for repairing tyres with benzol or mineral naphtha. About equal parts of each will be found sufficient. This mountant is brushed over the back of the print with a stiff brush, and the print is kept under pressure, after mounting, for several hours. Indiarubber mountant does not interfere with the gloss of a print in the least; but it has the very serious drawback that the rubber perishes after a few months and the print drops off its mount. It sometimes appears to stain the whites of the print, but this will be found to go off after exposure to the air for a little while.

Ordinary starch paste is of all mountants that which is least likely to affect the permanence of the print; but it should be freshly prepared and used cold. An excellent mountant of this character, but prepared by a patented process which gives it a curious consistence, is known as "Higgins'." It will keep very well, and is quite without any injurious action on the print. Ordinary gum or paste should on no account be used.

With a mountant such as "Higgins'," which contains comparatively little water, it is easy to mount P.O.P. prints, keeping their gloss. The mountant is spread over the back of the print, which is put face downwards on a clean piece of newspaper, and is quickly and evenly rubbed into the paper. There is no tool to equal the finger-tips for this purpose, and as soon as the peculiar greasy feel is noticed all over, the print is placed in position on its mount, another clean piece of newspaper is placed on the face of it, and it is well rubbed into contact all over, particular attention being given to the edges. The paper may then be changed for a fresh piece in case any of the mountant has exuded, and the print placed under pressure to dry.

Sheets of a thin waterproof paper can be purchased which may be pasted with starch or mountant on to the back of the prints while they are yet on the glass or ferrotype. The paper should be slightly smaller than the print, so that when both are quite dry and stripped, the trimming brings both to the same size, and the waterproof paper enables the print to be mounted without loss of gloss; but this method is going out of use.

Cut-out mounts, into which the print is simply pushed into

position, are the most popular form to-day; but are only of use to beginners, or to those whose photographs are simply records, and are not intended to have any pictorial value. This follows of necessity, because the cut-out mount is of a stock size determined by its maker, quite without reference to the particular print it is to surround, and its suitability therefore can only be occasional, and a mere matter of chance. For such record prints, however, they are very convenient. The visible portion of the print need not be touched with mountant at all, although a spot should be applied to one of the edges to keep the print from shifting about behind the mount. When a pile of such prints are kept together, loose or bound up into an album, the mount prevents anything from touching the surface of the print, so that they are very suitable where the preservation of the print is a matter of great importance.

A process of dry mounting has been introduced during the last few years. The print has interposed between it and the mount a thin sheet or skin of the same size, which has been treated with a preparation of shellac or other resins on both sides. The two are pressed closely into contact by a hot iron, or in larger sizes in a steam-heated press, and the heat melting the coating on the interposed skin binds both print and mount to it. The advantage is twofold. Curling is prevented, since both print and mount are quite dry at the moment of mounting, while the skin insulates the print from the mount by an almost impermeable barrier, so that any deleterious matter in the card is prevented from reaching the print.

In large sizes special apparatus, as just mentioned, is necessary for dry-mounting; but the amateur will find that it is perfectly possible to mount small prints with nothing more of an outfit that a few sheets of the tissue and a hot domestic flat-iron. To do this, the untrimmed print should have a piece of the mounting tissue about its own size placed on the back of it, and just touched with the warm iron. The tissue will adhere to the print at the part touched, and the two may then be trimmed together. The print is adjusted in position on the mount, and when this has been done with the needful accuracy, one end of the print may be lifted up without the tissue, and the tissue lying on the mount touched with the iron. This will cause the

tissue to adhere to the mount also, so that the print will no longer shift about on the mount, since the tissue adheres in one spot to the mount and in one to the print. Perfect adhesion all over is secured by pressure with the iron. The difficulty most likely to be met with is that of getting the iron to the right temperature. If it is too hot, the tissue adheres to the mount, but not to the print; if too cold, to the print but not to the mount.

The bending or cockling of mounted prints is to some extent inevitable, since we have two distinct substances united together, which substances may expand or contract quite differently in the circumstances to which they are exposed. If a print is mounted on a card and a spoiled print of the same kind, or failing that a piece of paper as like it as possible, is mounted in the corresponding position at the back, the pull of one counteracts the pull of the other, and we have the most favourable conditions for flatness. Keeping the mounted prints for some time under pressure helps to preserve their flatness; and if there is any risk of them sticking, the waxed paper in which plates are often wrapped is a good material to put in between them. The tendency to curl is reduced by taking care that the print and its mount, when brought into contact, are as nearly as possible in a similar hygroscopic condition. Mounting a thoroughly damp limp print on a dry mount makes curling inevitable. The dry mounting process just described is almost perfect in its power of preventing cockling.

CHAPTER XV

PLATINUM PRINTING

Simplicity of the process—Care of the paper—Damp—Artificial light for printing—Suitable negatives—Development—Warm tones—The acid baths—Development with glycerine — Permanence — Gold intensified platinum prints — Packham's process—Restoring discoloured prints—Printing on fabrics—Defects.

IF simplicity in a printing method means the reduction in number of those processes which call for personal skill, and the absence of complications in the few that are left, the platinum process stands pre-eminent. The image is visible during printing, nothing like so plainly as in P.O.P., but quite visible enough to act as a guide. In fact, it is no harder to learn by looking at it when a piece of platinum paper is sufficiently printed than it is to do the same with a piece of P.O.P. In each case an allowance has to be made for alteration in subsequent processes, and although the alteration is far more in the case of platinum, this does not make the process harder. Besides, when the paper is taken out of the printing frame, all call for skill or for anything more than ordinary care is at an end. It is put in a developer—a plain solution of one substance in water—it is developed as far as it will go, and is quite unaffected by being left longer in the developer. In fact, anything from thirty seconds to thirty hours makes no difference to the print. When the development is over, it is rinsed first in weak acid, and then in water, and is finished. The charm of a platinum print is unquestioned. Its pure black and white make it suitable for every subject, without exception ; its plain, smooth surface, free from the slightest suggestion of a coating or layer, appeals to the most cultivated taste, while the permanence of the print is limited only by the endurance of the very paper on which it is printed.

The greatest hindrance at present to its popularity, and

especially to its use in tropical countries, is the fact that even in hermetically sealed tins, with a due supply of calcium chloride, the paper will not keep indefinitely, and in a trying climate it spoils in a few weeks ; although there are methods, such as the addition of a trace of potassium bichromate to the developer, by which such spoiled paper can be used. Platinum paper should always be stored in a cool place.

Artificial light has been used for platinum printing, as the paper is sufficiently sensitive for the exposure of a powerful illuminant not to be prohibitively long. This at times is very convenient. The arc lamp can be used, and during the last few years the Cooper-Hewitt mercury-vapour lamp has been extensively employed for the purpose. A couple of mercury-vapour tubes with a rack to hold the frames some 8 or 10 inches away, will give twenty or more fully exposed whole-plate prints in 10 minutes or a quarter of an hour. But daylight is, and will probably continue to be, the light *par excellence* for platinum printing. It should be diffused, and not direct sunlight, and, as in the case of P.O.P. printing, the weaker the negative the weaker the light in which it must be printed, if a strong print is wanted.

As platinum paper is distinctly more sensitive than P.O.P., and as the injurious effect of exposing it to light is not seen until the paper is developed, care must be used in filling the frames lest it is exposed to light too long. Damp is still more injurious to it, so the paper in the printing frame is backed up with a piece of thin sheet rubber. Indiarubber is not the only substance that can be used for the purpose. Sheet celluloid, such as can be got by cleaning the coating off a spoilt film negative, answers excellently. Even with this precaution, if the paper is left in the frame too long it will deteriorate, in token of which a print left all night in the printing frame is never so good as one made and developed within an hour or so. It is said that negatives for platinum printing should always be varnished, because of the moisture held in the gelatine film ; but this is an unnecessary refinement. When the paper is taken from the printing frame, unless it is to be developed at once, it should be put back into the calcium tube.

A printing frame which has its hinges nearer one end than

the other will be found convenient in platinum printing, as more of the print can be seen, and it is easier to determine exactly when printing is done. The change is from a strong yellow to a greyish tint, and in noting how far printing has progressed, the grey should always be compared with the unaltered paper, which may be under the mask or protected by the edge of the frame. The printing is finished when the highest lights in the print are just distinguishable from the unaltered paper; but a few attempts show better than any quantity of verbal description, the appearance of the change and the extent to which it should be allowed to go.

Some workers find it more satisfactory to use an actinometer for printing, and not to open the printing frame at all until the process is finished. The subject of actinometers is dealt with more at length in the next chapter. There is no reason why one should not be used; in fact, anything that tends to prevent the access of light or damp air to the paper is beneficial; but the idea that they are required on account of any difficulty in determining from the appearance of the paper whether or no printing has gone far enough, is erroneous. Prints that are to be of a sepia colour are printed a little deeper than black prints, and those which are to be developed in a hot developer need not be printed quite so far as those to be developed cold.

In platinum printing, as in every other purely photographic method, the quality of the print depends primarily upon the quality of the negative. A very thin negative is not at all suitable for the process, although it may give satisfactory prints on "gaslight" papers, or by direct enlargement on bromide paper. At the same time much depends on the character of the subject, and the most beautiful portrait prints are made from negatives which the photographer of landscapes would think were too thin to print at all. The very best prints are always made from those negatives which are the hardest to print—from those, in fact, which must be printed "just right" and no more. These are the thinnest that will give good prints at all. If they have more contrast, they are much easier to print, there is a certain latitude, and a little longer or shorter in the printing frame only makes the print a little lighter or darker without actually spoiling it. But the result is never

quite so good. Very hard negatives—always supposing that they were properly exposed—are best printed on the sepia or the hot-bath papers, but a negative which will give a good carbon print, may be too dense to yield a satisfactory one on any kind of platinum paper.

The definite character of the development of a platinum print has put out of court with it all question of remedying in development errors of exposure. They lead straight and unerringly to failure. The print is therefore placed in the developer until no further action is taking place, any attempt at stopping development prematurely giving an unsatisfactory print. A simple developer may be made out of a stock solution of neutral potassium oxalate.

The instructions supplied with platinum papers usually state that the developer should not be used at a lower temperature than 60° Fahr.; but this should be regarded as an undesirable minimum, and better prints will be obtained if the developer is always placed in warm water for a little while before use, so as to take the chill off. That treatment which is most congenial to a bottle of Burgundy is quite sufficient for the purpose, when plain black tones are wanted.

The Platinotype Company still supply to order "hot-bath" paper, the predecessor in point of time of the present "cold-bath" paper. This is developed on a hot saturated solution of potassium oxalate; the temperature may vary from 100° to 180° Fahr., but 140 Fahr. is a suitable mean. Some workers prefer the hot-bath paper on the ground that it gives richer blacks; but it is doubtful how far this is borne out in practice. Plenty of photographers develop the cold-bath paper in a hot developer.

There are two methods in use for heating the developer for platinum prints. It may be poured into a glass flask, and held over a spirit-lamp either with the bare fingers or, if it is to be made very hot, by wrapping a few thicknesses of paper round the neck of the flask; or it may be heated while in the dish in which development is performed. For individual prints, the first-named plan is convenient, the hot developer being poured over the face of the print as it lies in a dry dish. If plenty of solution is used, there need be no fear of bubbles. The latter is preferable if a number of prints are wanted all of the same

tone. The dish should be one of enamelled iron, and it can be placed on a support, such as a brick at each end, or directly on a gas or oil stove. A better plan is to place on the stove a sheet-iron tray containing sand to a depth of an inch or more, and to bed the enamelled iron dish in this. When the temperature of the developer is correct, the stove may be turned down, and it will be found that the sand helps to keep the heat very constant.

The demand for the temporarily unattainable never ceases. Silver prints gave purple and violet tones, and photographers craved for a pure black. They got the platinum process which gave them what they wanted, and at once demanded warm colours in platinotype. What was asked was granted, and there are two or three ways by which for the black of a print in platinum a brown may be substituted. Mere alteration of the developer will do much. Using the cold-bath papers of the Platinotype Company, we have a range from the blue-black, obtained by using the "D" salts in a cold solution, or a cold solution of potassium oxalate strongly acidified with oxalic acid, to an orange.

The plain oxalate solution (one in four) diluted with twice its bulk of water, and used at 140° to 160° Fahr., or even hotter, gives a strong brownish black, a very agreeable colour. If a kettle of boiling water is at hand, and we hold the undeveloped print in its steam for half a minute before developing in this same hot solution, the brown is still more pronounced. Generally speaking, the hotter and the weaker the developer, the warmer the colour. One worker of our acquaintance gets a very rich brown by boiling the oxalate bath in a glass flask over a spirit-lamp, and pouring the liquid out of the flask straight over the print as it lies face upwards in a clean, dry dish.

Still warmer colours can be obtained by adding a trace of mercuric chloride to this hot solution, and it is proof of the minute trace of mercury that is sufficient to affect a change in the colour of the paper to point out that a platinum print from a negative that has been intensified with mercury is distinctly warmer in colour than one from an unintensified one, showing, as is indeed known to be the case from other evidence, that the negative had parted with a trace of its mercury, although hundreds, or even thousands, of such prints might be obtained

MISS MINNIE ASHLEY

BY MRS. KASEBIER

without any effect being manifest in the negative itself. The proportion of mercuric chloride to be used in the developer varies very much with the fancy of the user.

A developer which gives prints of a warm brown colour on the C.C. paper of the Platinotype Company was described by Mr. C. F. Inston to the Liverpool Amateur Photographic Association in 1902. The following is its composition:—

Neutral potassium oxalate	2 ozs.
Mercuric chloride	90 grs.
Potassium citrate	150 grs.

These are covered with 14 ozs. of cold water, and when dissolved the solution is ready for use. Equal parts of this solution and hot water (not boiling) are mixed together and poured over the dry print as it lies face upwards in a dish.

Nothing is to be gained by multiplying formulæ for these warm tones; what have been given already may be taken as typical. So long as mercury is not present, it may fairly be assumed that, whatever the colour of the image, it consists of metallic platinum, the colour being dependent upon the size of the minute particles of which the image is built up. This may seem strange to those unacquainted with physics; yet it is a common occurrence for one and the same substance to have differing colours at different times, due to this cause alone. So long as the image consists of platinum only, its permanence is indisputable, whatever the colour. Moreover, it is not affected by the acid baths used to get rid of the iron from the paper. But when mercury is present in the developer, the result is by no means such a foregone conclusion. Mr. Chapman Jones, who has made a special study of platinum processes, thinks that in such a case the image is probably contaminated with mercury, although in the sepia paper of the Platinotype Company, in spite of the presence of mercury in the developer, he thinks it is not. Certainly, in the case of prints on cold-bath paper developed with hot solutions containing mercury, such as that given by Mr. Inston, the acid baths must be much weaker and applied for a shorter time, or the warm colour will be removed and a cold print of a washed-out appearance will alone be left.

The Platinotype Company has always deprecated the

attempt to get sepia tones on papers prepared for black tones, and has put a special paper on the market for those who want warm colours. The paper has to be developed with a solution of certain salts which they supply for the purpose, and yields prints of an excellent sepia colour, upon whose permanence reliance may be placed. At the same time, it is probable that a greater number of warm-toned prints to-day are made upon the black papers than upon the sepia, since the greater range of colour, and the fact that black or brown can be obtained on the same paper at will, are advantages not to be despised.

Before the war, a long range of platinum papers giving black, warm black, and sepia prints was made by Gevaert, of Antwerp. A very beautiful variety of these was coated upon Japanese vellum, and supplied both for black and for sepia. For the latter a hot developer was used. The paper was comparatively expensive, a whole-plate piece costing ninepence; but with certain subjects the effect of the delicate semi-transparent paper was particularly good. It had to be handled very carefully, when dry, as it was very brittle, but was tough enough while it was wet.

In the ordinary way, the print is taken out of the developer and placed direct into a bath of weak hydrochloric acid, 1 oz. of the acid being added to 60 or 80 ozs. of water. Commercial hydrochloric acid has a yellow colour, and is contaminated with iron. As the acid is applied to get the iron out of the print, clearly this is unsuitable. The acid should be water white when looking through a thickness of 3 or 4 inches of it. The print must on no account be placed in water between development and the acid bath, or the iron will be precipitated in the paper and will not be removable. Mercurially developed prints should be placed in one bath of ½ oz. of hydrochloric acid to 100 ozs. of water, allowed to remain in this for three minutes, transferred to a fresh bath of the same strength for another three minutes, and then washed in plain water. As the only objection to further acid baths is the removal of the brown colour, if it is found that more can be given, they should be used, as they certainly increase the likelihood that the print will be permanent. Ordinary black prints may have a minimum of three baths of the strength just mentioned, transferring them one by one and draining them well before putting them in the fresh acid. More than three

baths are advisable when a number of prints are being dealt with, the instructions of the Platinotype Company stating that the last acid bath, after use, should be quite colourless when seen in a depth of 2 inches. Instead of hydrochloric acid, citric acid may be used, ½ oz. to the pint of water being a convenient strength, though stronger solutions have been recommended. This substitution makes the process a more convenient one for travellers, as the hydrochloric acid is too corrosive to be carried with ordinary luggage.

After the acid baths the prints have to be washed to free them from acid. In doing this it will be found, if the acid baths have been too strong, or if the prints have been left in the acid too long, that the surface of the paper has become very tender, and the rougher papers may even injure each other by lying on top of one another. If the acid has not been stronger than one in sixty, and the total immersion in acid has not exceeded half an hour, there should be no trouble from this cause. Four or five changes in water, draining between each, are sufficient to remove all traces of the acid, and the prints are finished.

It does not hurt platinum prints to dry them between blotters, as there is no gelatine on the surface to cause them to adhere. In warm weather they are best blotted off and dried as soon as possible. The author had some prints entirely ruined by being put away in summer time for about a week while still damp. They were blotted off as thoroughly as possible, a few pieces of blotting paper were arranged top and bottom, and the prints in a pile between them. The whole was put away under pressure for a few days, at the end of which time a fungoid growth, or mildew, which could in no way be removed without spoiling the print, had badly marked nearly every one—quite ruining them. In a dry print it is impossible to suppose that there would be any risk of this.

If a developer diluted with water were applied to a platinum print with the idea of developing it in parts or by degrees, stopping the action in one place and continuing it in another, failure would result; because the water would dissolve and remove the platinum salt before the iron salt which had altered under the light's action could decompose it. But if the developer could be diluted with some inert substance which

would make its action gradual and under control, but which itself would be incapable of dissolving the soluble salts in the paper, we should have what we require. Such a substance is glycerine; and by the use of it in combination with the ordinary developer, the photographer has a very great power of control over his platinum prints—a power which he can get in no other way. To use the method the usual cold developer is mixed with glycerine in two or three different proportions Thus we may have three vessels—saucers are handy for the purpose—containing respectively ½ dram, 1 dram, and 4 drams of the developer, to each of which 4 drams of glycerine has been added and well mixed up. The print is placed face downwards on a piece of glass, while a little glycerine is well rubbed into the back with the fingers; it is then turned over and glycerine rubbed into the front in the same way. This should be done in bright artificial light, as it is very necessary to see what is happening, though the paper is as sensitive to daylight under its glycerine coating as it is at any time. The surplus glycerine being swept off the print on to the glass with the fingers, these may be washed and wiped and development taken in hand. With a brush charged with the most dilute of the developer-glycerine mixtures, those parts of the picture which are to appear in the finished print are covered, and then using one or other of the mixtures as may seem to be required different parts are brought out or held back at the will of the photographer. Where the action is progressing too rapidly the developer is wiped off and glycerine applied; where it is not going on fast enough the stronger solution is used. In this way it is sometimes possible to get effects which are only to be obtained otherwise by oil printing or by bleaching. But the comparative rapidity with which the action takes place makes a great demand upon the user's skill and decision. Anything once brought out is irrevocable, and it is not easy to stop the action at once in any particular part, nor is it possible to follow fine lines or to adhere closely to outlines, as the action always tends to spread.

When carrying out any modifications of this kind—and by no means is the observation limited to the platinum process—it will be found a very great help to have a copy to which to work. This can be made by taking a plain, straightforward

print from the negative and drawing on it with chalk, obliterating what is not wanted, and lightening other parts, until the best effect is obtained. The chalk can be wiped off with a cloth that is slightly damp, and no attempt should be made with the developing process until the general effect obtained with the chalk is seen to be what is wanted. When this is the case, the copy may be fixed up behind the sheet of glass on which the print is being developed, and the pattern so supplied followed with the glycerine treatment. The process is seen at its best in irregular vignettes, where it is used to suppress parts which otherwise would interfere with the composition. It is said that there is sometimes trouble from uneven tones in the lighter parts—that is to say, those which are light, not from the opacity of the negative there, but from the process being employed to prevent them from fully developing. These are warmer in tint than the shadows; but using a strong solution of oxalate (one in four), slightly acidified with oxalic acid, the author has not met with any trouble on this score.

Stieglitz and Keiley exhibited some every effective platinum prints in two colours a few years ago, and published a pamphlet giving a description of the method employed. There was nothing of a very startling character in the process, which was merely the use of a developer containing mercury for the warm tones—the flesh tints, as a matter of fact—and a normal developer for the rest; but the skill with which it had been used drew attention to it. No one seems to have succeeded since to the same extent; but the method affords scope for those who have sufficient taste and skill; the former requisite is particularly essential, as it is easy to produce the most absurd discords by the method. If any attempt at brushwork is made, on no account must the brushes used for the developer containing mercury be employed afterwards for the normal solution. The slightest trace of mercury is sufficient to change the tone, as we have seen, and it is quite impossible to wash a brush free from such slight traces.

Prints on any part of which mercury has been used must be washed in the very dilute acid only, or the print will suffer. Any print developed with glycerine on being put into the acid bath should at once have its surface gently rubbed with cotton wool, to remove the glycerine and developer as quickly as

possible. If this is not done, development may go on too far, and the print be spoilt.

The unalterability of platinum not only gives the process its distinctive note, its permanence, but it makes it particularly hard to modify the platinum image by those methods to which a silver picture is so easily susceptible. There is no known method of reducing a platinum print satisfactorily; but there are several by which other substances can be attached to or deposited on the platinum, either to alter its colour or to intensify the image. The best and most economical method of dealing with a print that is too weak is to tear it up and make another.

A weak print may be used as the basis for a strong one of a very cold tone, if this is desired, by employing Dollond's process. The finished print is soaked in water until it is limp, blotted surface dry and placed on a sheet of glass, or on the bottom of a dish, and a little glycerine is spread all over its face. Then some of the ordinary stock solution of gold chloride (one grain to one dram) is taken and spread over the face of the print with a soft brush, mixing it well in with the glycerine. The print soon commences to tone and to increase in vigour, and the brush should be kept going over the surface as long as the toning is continued. When it has gone far enough the print should be washed for two or three minutes, placed for a minute in an ordinary metol developer, such as is used for negative work, and then again washed for half an hour or so to remove all traces of the developer. The developer has no visible action, the toning being complete when the gold is washed off, but is used to decompose any gold solution that may be left in the pores of the paper, and without such treatment might cause discolouration of the print afterwards.

A curious method of toning platinum prints is due to Mr. J. Packham. If a finished and washed platinotype is immersed in a solution of the vegetable dye, catechu, the paper is not dyed, but the image gradually becomes brown. It was subsequently shown by Mr. Chapman Jones that the action depends on slight traces of the iron salt still remaining in the image after all the acid washings to get rid of it, and not on any action between the dye and the platinum itself. This is immaterial to the user of the process, and the method gives a

fairly permanent result. Catechu, or cutch, is the dye used for ships' sails, and gives them that rich brown colour which is so effective pictorially. Incidentally it helps to preserve the sail. Two drams of dyer's catechu or cutch in powder is boiled in 5 ozs. of water for five minutes, allowed to cool, and has added to it 1 oz. of alcohol. This forms the stock solution, and keeps indefinitely. Half a dram of this liquid is added to a pint of water, the solution is heated to 130° to 150° Fahr., and the print is immersed. Toning starts at once, and can be stopped at any moment that seems desirable, the operation having gone as far as it will go in about ten minutes. Toning may be done with a cold solution, but this takes much longer, up to four and twenty hours.

There are a whole string of processes for altering the colour of platinum prints by depositing silver on the platinum image, or by toning it with uranium and then either leaving it with the colour imparted by that operation, or by turning it some other colour by reacting on the silver or on the uranium compound. There are several reasons why such methods are little known and seldom used. They all, without exception, damage the permanence of the print. Not that the original platinum image is made less permanent by them, but the applied substances are liable to change. The only methods which give a reasonable promise of unalterability are the gold toning just described, and a process of intensification by depositing more platinum on the platinum image, which has no advantage to recommend it. Then in most cases the colours obtained are too positive—violent greens, crude blues, and assertive reds are seldom effective as the single tint of a monochrome ; and when the colours do not have this most undesirable characteristic, they are such as are more conveniently obtained in other ways. A platinum print, it may safely be said without fear of an accusation of unreasonable dogmatism, should be black or brown black ; and for these tones it has no rival in pure photography.

After all that has been said about the permanence of platinum prints, it may seem to be a contradiction to talk of their fading, and to give a remedy for it. Strictly speaking, platinum prints do not fade ; and if the whole of the processes have been properly carried out—surely not much to expect—they will not alter in any way. The last traces of the iron

cannot be eliminated without risk to the print, it is true ; but if any that is reasonably removable is left in, the print may gradually discolour, turning very much the same colour as a faded silver print. A bad quality, impure mount may help to bring about such a state of things. But this is not true fading, and anything that will remove the iron will at once restore the print to its original condition. Mr. Chapman Jones has recommended a solution of hydrochloric acid, one part of acid to twenty of water, to which has been added a few drops of a solution of sodium hypochlorite. Enough of this should be poured in to give the mixture a distinct smell of chlorine. Those who do not know what the smell of chlorine is like need not regard this as an insuperable difficulty. They can add the hypochlorite until they can smell something else besides the hydrochloric acid, and that will be chlorine. They will thus learn what chlorine does smell like, an increase of knowledge not accompanied by that increase of pleasure which is generally supposed to repay intellectual acquisitions. The print is placed in this liquid until it has reassumed its original condition, after which it is washed and dried.

The platinum process has been used for printing upon fabrics, and at one time quite a variety of materials could be obtained ready sensitized for this purpose. But the demand was never a great one ; and their manufacture has been discontinued.

Some very fine exhibition work has in the past been produced by making an ordinary platinum print, but taking care to keep it on the light side, and then sensitizing it and printing it from the negative a second time, this second printing being by the gum-bichromate process, as described in the next chapter. In this way, a delicacy can be got in the lighter tones which it would be difficult, if not impossible, to get with gum-bichromate by itself, while the gum picture can be used both as a means of control, and to give vigour and depth to the darker tones. It is possible also that the oil process may be used for the same purpose, and it is likely that it will be found superior to gum-bichromate as a means of producing a print in combination with platinum.

What has already been said should be sufficient to show that the claim of simplicity for the platinum process is not

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without an ample basis. There is little likelihood of trouble that cannot be traced immediately to careless manipulation. The only defects which need reference here are solarization or bronzing in the deepest shadows, mealiness or granularity in the prints, and weakness and washing away of the image. Solarization is not due to any imperfection in manipulation, but to the use of a negative that is too strong in contrast for the paper employed. In this respect the Kodak platinum paper is very notable, as with it solarization seems almost impossible. If the whole of the film is stripped from the borders of the negative so as to leave clear glass, the severest test that could be supplied, the print on Kodak paper will be found to have a deep rich black border without any tendency to bronze, unless the negative is very opaque. Mealy or granular prints may be due to weak developer or to the use of a suitable developer at too low a temperature, or to the paper being stale; but the commonest cause is damp. If the damp has reached the paper after it was taken from the calcium tube, precautions should at once be used to prevent further prints being spoilt in the same way. These would take the form of drying the negatives and pads thoroughly before the fire, and taking care that the paper was put back into the calcium tube after printing, until it was to be developed. If the damp has reached the paper while in the storage tube, little can be done. It is said that by drying the paper in an oven that is not too hot, and then printing it and developing with a normal developer to each ounce of which half a dram of a ten per cent. solution of potassium bromide has been added, much better results can be obtained. Or ten minims of the hypochlorite and acid liquid referred to on p. 208 may be added to each ounce of developer. A little carbonate of soda added to the developer is useful if the paper is stale; but all these are only devices to make the best of a bad job, and good prints can only be obtained by the use of paper in the best condition, kept perfectly dry until development, and developed in the normal manner.

CHAPTER XVI

THE CARBON PROCESS

Tissue—The necessity for transferring—Ready sensitized tissue—Its storage—Measuring the printing—Actinometers—Sensitizing tissue—Bennett's formula—Drying tissue—The safe edge—Development—Single transfer—Stripping negatives—Double transfer—Double printing—Spotting—Carbon transparencies—Bichromate poisoning—Ozotype—Gum-bichromate—Mr. Mummery's method—Multiple gum—Single coatings—Oil printing and bromoil.

NOTHING could have been farther from the thought of Mungo Ponton, ninety years ago, when he noted that gelatine containing bichromate, after exposure to light, lost its power of dissolving in warm water, than that he was making one of the most fundamental discoveries of photography. Yet such it was; and the carbon process is only one of many which are based upon it. It can hardly have looked very promising; there was no visible change of colour, or, at least, what there was can only have been very slight; it did not seem to lead to anything of importance; the sensitiveness was not great; it was a mere curiosity. It was left for Poitevin, Swan, and Woodbury to show bichromated gelatine as the most Protean of the genii who obey the possessor of the ruby lamp. We are concerned for the moment with the "carbon" process only, a process in which carbon does not necessarily play any part at all. Whoever dubbed it must have been content, like David Copperfield, Senior, to see the nests and take the rooks on trust. He perceived that *if* carbon were used as a pigment, the process was a permanent one, and it was the "carbon" process for ever after.

The process in outline is simple enough, nor is it complicated in practice. If gelatine, potassium bichromate, and some colouring matter are thoroughly incorporated, and a thin coating of the mixture is applied to paper, we get, when it

is dry, a sensitive preparation upon which we can print. For the moment, we will suppose it to be printed with the back, or plain-paper side, towards the negative, so that the light has to strike through the paper to reach the coating. The precise nature of the colouring matter, so long as it is unaffected by the bichromate and is permanent, does not matter much. Such paper is known as carbon tissue. After exposure, no image is visible; but on soaking the tissue in cold water for a little while, and then placing it in warm water, signs of a picture may make their appearance, the gelatine and pigment washing away where the light has not yet acted. In a short time we shall find that no more of the gelatine will wash away, and, if the exposure has been correct, that the paper bears a passable print from the negative. It will have two serious defects, however—owing to the print having been made through the paper, it will be grainy and coarse; and for the same reason it will be the wrong way round, or reversed as regards right and left. The process thus outlined is nevertheless quite practical for large sizes, and a few years ago some very good carbon prints made in this way were shown by Valentine Blanchard. Subsequently this form of the process was revived by the Rotary Photographic Company, who used thin sheet celluloid as the base, instead of paper, and so evaded the difficulty of the grain. In printing through the paper there is also trouble from the length of exposure required, and from the discolouration of the paper with the bichromate. Why, it may be asked by some one not familiar with carbon printing—why not print direct on to the coated surface of the paper? The answer to this question brings in the whole difficulty which confronted the original inventors.

The mixture of gelatine and pigment is necessarily an opaque, or at least a deeply coloured one. When it is exposed under a negative, with its outer surface next the film, the light strikes that surface first, makes it insoluble, and this insolubility only extends a little way down into the film of gelatine. Let us suppose that Fig. 16 represents in a much magnified form a cross-section of a piece of sensitive carbon tissue. The paper support is shown at A, and the gelatine and pigment at G. The light coming through the negative reaches the top surface of G, and the depth below that surface to which

its action extends is governed by the different densities of the negative and by the exposure. Let us suppose the shading represents the part of the film G, which, after sufficient exposure, is rendered insoluble ; H would be a high light in the print, and S a shadow. Now, if such a piece of tissue were put into warm water, it will at once be evident that when the still soluble gelatine, the lighter shaded part, had dissolved, there would be nothing to hold the insoluble film on to the paper, and it would float off and wash away.

Accordingly, in the earlier stages of the process, a sheet of paper was cemented on to the top of the printed tissue by

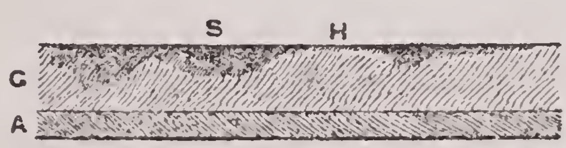


FIG. 16.

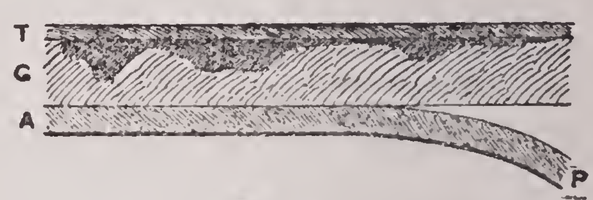


FIG. 17.

means of indiarubber solution, and then, when it was all put into warm water, the original paper support could be pulled away, as at P in Fig. 17, and the gelatine picture adhering to the fresh paper support T was not only not in danger of being washed away, but was in a better position for the warm water, which then had direct access to the soluble part of the film, to dissolve what was not wanted. It was this process of transferring which made carbon printing a practical success. Such a discovery would make the reputation of an inventor, but it is only an incident in the long series that the world owes to Sir Joseph Wilson Swan. Still, as the first of that series—it was made in 1864—it may perhaps have prominence beside bromide paper and the incandescent electric lamp.

Swan having shown the way, J. R. Johnson followed four years later with a remarkable simplification, which left the process where it stands to-day. By applying paper coated with gelatine to the printed carbon tissue while it was still in cold water, after it had begun to soften and swell, but before it had absorbed all the water it could hold, Johnson found that it went on absorbing, and in doing so cemented itself to the coated paper so that no indiarubber solution or other compound was required.

The transferred print, like the print made through the paper

support, is reversed as regards right and left. In many cases this does not matter, but in some it is important; and Swan got over the difficulty by transferring first to one paper for development, and then again transferring the print to a "final support." In 1874, Sawyer introduced his "Flexible Temporary Support," and the carbon process was in every respect what we see it to-day.

No amateur photographer thinks of preparing his own carbon tissue; he can get it in some fifty or sixty different shades, from two or three different makers in this country, and amongst them he must be hard to please who cannot be suited. One great feature of carbon work is that almost any pigment which is not affected by the bichromate may be used. The result of this is that there is no colour whatever in which a carbon print cannot be made, if it is desired. The most popular colours—and, on the whole, the most universally suitable—are engraving black, warm black, standard brown, red chalk, and standard purple. The last named is a colour based on that of a toned-albumenized print, and is not so pleasant as the others. There are a number of other colours—shades of brown mostly—each of which has its admirers, while dark blue and sea green are appreciated by those who do not mind their assertiveness. A special form is known as "transparency tissue." It is supposed to contain Indian ink as a pigment. Not that we would suggest that this is not so, but merely that the manufacturers do not commit themselves as to the ingredients used. The transparency tissue, as its name implies, is most suitable for transparencies on glass; but it may also be used for paper prints of a rich brown-black colour, and is distinguished for the extreme fineness of the pigment it contains, and for a larger proportion of pigment to gelatine than is usual in the case of tissues made primarily for prints on paper.

Any one working the carbon process for the first time will probably buy the tissue sensitized ready for use; but sensitizing at home is so much more economical in the long run, is very little trouble, and gives quite as good results, that as soon as the process has been mastered, the tissue is sure to be purchased in its insensitive condition. When buying it sensitive, it is usual to find out the day of the week on which sensitive tissue is coated, so that it can be bought quite fresh. It is

actually sensitive tissue that is coated, and not a mere sensitizing of already coated tissue, the bichromate being added to the mixture that is applied to the paper.

One of the greatest hindrances to the popularity of the carbon process is the fact that sensitive tissue will not keep. It begins to deteriorate from the very first day, and if kept without special precautions is useless in a week or so. If kept flat, under pressure, so as to exclude the air as much as possible, it keeps longer; and in a calcium tube it will keep for months. But it is never so good as when it is used within a day or two of being made or sensitized; and herein lies the advantage of home-sensitized tissue.

The tissue, sensitive or not, looks like some curious form of plaster. It is not easy to distinguish the colour of the pigment used, as, in its thick coating, it looks almost black, unless a very marked colour is employed. For this reason, and to avoid mistakes, the colour of each piece should be written lightly in pencil on the plain paper back. The tissue is sold in rolls or in cut pieces. Sensitive tissue is best bought cut to size, as this reduces the risk of injury by handling; but it is more economical to buy insensitive tissue by the roll or half-roll, and to cut off pieces of any size or shape that happens to be required. In an ordinarily dry drawer or cupboard insensitive tissue keeps as good as ever for unlimited time. The packet of cut sensitive pieces should be kept in a cool place, away from gas or other injurious fumes to which it is almost as susceptible as a dry plate. Heat and damp together are particularly inimical to it. The surface of the sensitive tissue should be handled as little as possible, and if it is very dry when it is received, it must be unrolled or unbent carefully, to avoid breaking the gelatine surface.

In addition to the carbon tissue, "single transfer paper" will be required; and this also can be bought either in cut pieces or in the band. The cut pieces are always a little larger than the size of the prints for which they are to be used: thus, 5 by 4 is supplied for quarter-plates, 9 by 7 for whole plates, and so on. As the surface of the final print will be the same as that of the transfer paper used, this is made in a number of different grades to suit different tastes; but the smoothest is that with which it is best to start operations, as

the rough papers, though not inherently difficult to use, at least call for a little more care and knowledge. Except the tissue, the transfer paper, and some potash alum, the carbon process calls for no materials that the photographer has not got at hand. One or two small pieces of apparatus are necessary.

The process of printing, not being accompanied by any visible change, can only be ascertained instrumentally. This is accomplished by means of an actinometer or print meter, an instrument which can be obtained in several patterns, but all based on the use of a piece of silver paper exposed side by side with the printing frame in which the carbon tissue is printing, the exposure being timed by the visible alteration in the silver paper. The simplest form of actinometer is a little piece of P.O.P. put underneath a negative of about the same density as that which is being printed in carbon. When the silver paper is about as dark as it ought to appear when finished —those who have read the chapter on P.O.P. will know that this is not the same thing as saying when the P.O.P. is properly printed out—the carbon print is about done. As P.O.P. varies very considerably in the speed with which it prints—as carbon tissue does likewise—and as it is no easy matter to decide correctly that two negatives are of the same printing density, it will be seen that this is an extremely rough and ready guide. Still, it is a guide, and many workers who produce very fine carbon prints use nothing more elaborate.

Johnson's actinometer is the simplest of special appliances. It is a cubical box which holds a roll of sensitive paper, whose free end is led underneath a piece of glass coated with a brown paint, which is quite opaque, but has a clear hole in the middle. The paper gradually darkens to the tint of the patch of paint surrounding it. When this is reached, the instrument is said to register "one tint," and the paper is pulled on a little so as to expose a fresh piece. This actinometer suffers from the disadvantage that it requires constant watching. If a carbon print is to be exposed for five tints, the paper must be pulled forward each time when it has properly darkened; and if from any oversight this is not done once, and the printing is allowed to go on beyond the tint on the actinometer, it is only by guesswork that we can decide to what extent that has taken place.

Mr. J. R. Sawyer therefore introduced a modification of the Johnson actinometer, which has a scale of graduated "densities" and takes a strip of paper, beside which runs the tint to be matched. There is thus no need to move the sensitive paper at all while making the carbon print: all that is necessary is to decide which of the densities represents the depth to which the printing should go, and to expose until the paper under that particular density has darkened to the standard tint. Wynne's print meter is another extremely neat little instrument of the same kind. Burton's actinometer is a further elaboration. It has a row of little negatives with densities in front of them, and a strip of paper beneath, printing being continued until the selected negative has yielded a print of the correct depth.

An actinometer of the Sawyer type is easily constructed, the densities being made by allowing pieces of thin paper, such as cigarette paper, to overlap one another, one density being formed of one thickness, two of two thicknesses, and so on. It is perhaps as well to point out that it must not be supposed that in such an instrument if one thickness of the paper requires a certain exposure, two thicknesses require double, and three thicknesses treble. The relationship is by no means so simple; but if no attempt is made to employ the relationship of one of the densities to that of another, a thing that should not be done in any actinometer, the indications are reliable enough. Whatever form of instrument be used, two cautions must be given if it is to be employed successfully. The angle which the front of the actinometer makes to the incident light should be the same as that of the negative in the printing frame, and the same make of sensitive paper should always be used in it. The actinometer is placed as near to the printing frame as possible. If several printing frames are being put out at the same time, one actinometer will do for all of them, if they are all started together; each frame is then taken in as the tint thought to be correct for that particular negative is reached.

If carbon printing is regularly practised, it is a good plan to mark on the edge of each negative the number of tints or actinometer densities which are the correct exposure for it, and, when different colours of tissue are used, to mark the tissue,

THE QUAY

BY T. F. BROGDEN

because the speed of tissue varies with its colour. This is only to be expected, since the picture is formed in the tissue by the depth to which the light penetrates into it and makes the film insoluble; and the more opaque the coating, the longer does it take for the enfeebled light which can get through the film to make it insoluble to the depth that is required. Therefore, the more opaque the colour, and the more nonactinic its tint, the longer is the exposure it requires.

There is also a considerable difference in the speed of the different makes of carbon tissue, and different methods of sensitizing have a great influence upon speed. The fastest is undoubtedly the ready sensitized tissue of the Autotype Company, and this also has the greatest tendency to give very clean whites. In fact, this is so marked, that in their handbook of the process the company recommend that the tissue be not used until a day or two after it has been sensitized, as in this way softer and better pictures are obtained. There is no particular advantage or otherwise in this sensitiveness, and sensitized at home the tissues of the company do not show any superior rapidity to those of other makes.

Sensitizing carbon tissue presents no difficulty whatever; and it should certainly be done by any one who thinks of using the process for his work generally. It is only in this way that it is possible to take full advantage of the range of colour which carbon affords. The insensitive tissue can be bought in pieces or in the roll, and a small stock of the different tints that are preferred may be kept. The night before any prints are to be made, one or two pieces of each colour wanted are taken and sensitized for use on the morrow. The tissue is thus printed while it is at its very best. If it is bought sensitive, the least that can be purchased is generally a dozen pieces, and these must be used up very quickly or they are wasted.

Until two or three years ago, the only sensitizing liquid used for carbon work was a plain solution of potassium bichromate, to which some people added a trace of liquor ammonia or of potassium carbonate. In October, 1903, Mr. H. W. Bennett described an improved sensitizing bath which he had worked out, from a suggestion made by Professor Namias, which had certain very marked good qualities. The orthodox

sensitizing bath to which we have referred was generally one of 5 per cent. strength—

Potassium bichromate	1 oz.
Water to	20 ozs.

Five drops of strong liquor ammonia were sometimes added, and it was usual in hot weather to reduce the quantity of bichromate to one-half or even one-quarter of that given above. This sensitizing bath keeps quite indefinitely, as indeed do those which are to be described. As the quantity is reduced by being absorbed by the tissue, fresh may be added so as to keep the bulk about the same. A Winchester quart (80 ozs.) is a convenient quantity to make up for sensitizing tissue up to 15 by 12 inches in size, but the greater the depth of solution in the dish, the easier does the operation become.

The sensitizing bath recommended by Mr. Bennett is made by dissolving an ounce of potassium bichromate in a pint of water, and a quarter of an ounce of citric acid in about the same quantity, and mixing the solutions. Strong ammonia is then added, two or three drops at a time, stirring after each addition, until the colour of the liquid changes from the deep orange red of the bichromate to a lemon yellow. As soon as this stage is reached no more ammonia is added, but the bulk of the liquid is brought up to 50 ozs. by the addition of water, and the sensitizing solution is ready for use. With some makes of carbon tissue, one-third this quantity of ammonia was found to be sufficient. This quantity is ascertained by taking one-third of the total bulk of bichromate and citric acid solution, adding ammonia until it changes colour, and then mixing it with the remaining two-thirds to which no ammonia has been added. It is not possible to give the quantity of ammonia, as this depends upon the nature of the sample of bichromate used and upon the strength of the ammonia solution, which latter is variable, the solution becoming weaker every time the bottle is opened. The only way is to judge by the change of colour, as has been described; but this is very marked, and involves no difficulty at all in practice.

Variations in the strength of the sensitizing bath and in the length of time the tissue is immersed in it, give corresponding variations in the character of the prints. The stronger the

solution, the softer will be the contrasts in the print; to obtain uniform prints from the same negative, not only should the sensitizing bath always be the same strength, but the tissue should always be immersed in it for the same time. The bath made up according to Mr. Bennett's formula, and used for two minutes, will be found to give a very satisfactory tissue. The Autotype Company recommend a bath which is practically a 5 per cent. solution of bichromate, applied for three and a half minutes, a time which is easily checked by means of one of the little "egg boilers." As potassium bichromate is largely used for manufacturing purposes there are several qualities on the market, some of which are anything but pure. It should be in clear orange-red crystals, with little or no paler-coloured dust adherent. The powdered bichromate, sometimes sold, should be avoided; both because its appearance gives no evidence of its purity, and it is exceedingly hard to dissolve, caking together and taking a long time.

A squeegee, a dish, a sheet of glass a little larger than the tissue, and a few dark-room pins are needed for sensitizing. A piece of the tissue, which should always be cut a little bigger than the finished print, to allow an edge for handling, is taken in both hands, and bent into a convex shape, with the coated surface outwards and downwards. Held like this the convex part is pushed under the sensitizing liquid in the dish, and then the hands being separated and lowered the rest of the sheet is submerged, starting from the centre and finishing at the edges, when it should all be underneath the surface; the time is then noted. In this way any air-bells are pushed to the ends and broken. If any air-bells are seen on the back they may be broken by touching them with the fingers, and the tissue is then turned over and the face attended to in the same way. A broad camel-hair brush is a convenience at this stage, and by brushing it gently once or twice in both directions across the face of the tissue all risk of air-bells is prevented. At the end of the time, the tissue is picked up by two corners, allowed to drain for a few seconds, and then placed face downwards on the sheet of glass and gently squeegeed from one end to the other to get rid of surplus bichromate solution. This is the only purpose of the squeegeeing, and it must be done without any vigour or the tissue will

be injured. The sheet of tissue may then be pinned up by two of its corners to dry.

All these operations can be done in broad daylight, as carbon tissue is only sensitive when in its dry state. Tissue sensitized on a plain bichromate bath must be dried where there is no risk of it being injured by gas fumes, which render the outer surface insoluble, and so prevent clean high lights from being obtained. If the citric acid and ammonia sensitizing solution is used, the tissue is far less likely to suffer, and may be dried in any ordinary room from which daylight is excluded.

If, after sensitizing, the tissue is squeegeed down on to one of the opaque pulp boards which are supplied for squeegeeing P.O.P., or on to a ferrotype sheet, it may be dried without removal from the ferrotype or pulp. This has several advantages. The opaque substance screens the face of the tissue from the light, and as the bichromate stains the paper back a very non-actinic colour, the tissue may be dried without injury from daylight in an ordinary room. It would be possible by placing it in a direct and strong light to spoil it in the process; but by avoiding any deliberately unnecessary exposure, the proceeding is quite free from risk. As the front surface of the tissue is that which forms the delicate high lights of the picture, and as anything which affects it is therefore more injurious than if it affected the back where it washed away, an absolute protection against fumes is afforded by drying the tissue in this manner. Finally the tissue leaves the ferrotype with a very glossy surface, which allows of the most perfect contact between tissue and negative during printing. Against this must be set the fact that drying in this manner takes longer, and requires a number of pulp boards or ferrotype, which must be perfectly clean.

On no account must the tissue be printed until it is perfectly dry, as if it sticks to the negative, as it will do if it is at all moist, the negative is ruined, while if any bichromate is absorbed by the negative, it is equally fatal, and a mark will be made which by no ingenuity can be removed. As there is no occasion to examine the progress of printing, the frame may have a solid back, or we may even dispense with the frame altogether. For large negatives the author uses a

drawing-board, on whose smooth surface the sheet of tissue is placed, covered by the negative, and the two pressed into contact by means of a sheet of stout plate-glass, which is prevented from sliding about by means of a few dark-room pins as described later on.

If an ordinary frame is used with a negative the full size of it, the precaution now to be described is not so necessary; but with a drawing-board what is called a "safe edge" is important. If a clear shadow on the negative comes right at the edge of the picture, the tissue underneath may be rendered insoluble so completely that it will not adhere to the transfer paper in development, but will form a kind of pocket or frill, underneath which the water will get, and may detach still more of the film from what should be its support. For this reason it is customary to provide all negatives that are to be printed in carbon with a black opaque border, preferably on the glass side. It need not be more than an eighth of an inch wide, and can be made with a brush and a little Brunswick black; but the usual method is to use the narrow strips of black paper sold for binding lantern-slides; they may be cut down the middle, as they are wider than is needed. By applying the "safe edge" to the glass side its border is vignetted a little into the picture, and there is no sharp edge of insoluble gelatine standing up on the paper. The "safe edge" ensures the extreme edge of the print being composed of soluble gelatine, which on development forms a kind of buffer, and prevents the film from washing up. For a similar reason, as the edges of a piece of tissue are invariably the parts which are first attacked by that gradual insolubility which constitutes its deterioration, it is decidedly convenient to sensitize pieces slightly larger than the negative to be used, and to trim a quarter of an inch off the tissue on all four sides, before exposing. If small sizes are worked, a better plan is to sensitize pieces a little more than twice or four times the size required, and to cut these pieces out of the middle.

The tissue, after being sensitized, is of course kept in the dark until it is required for use, and after it is taken out of the printing frame, it is similarly preserved from light. If it is put into a calcium tube, it may be kept for a long time between printing and development without alteration of any kind,

provided the drying action of the calcium is efficiently performed. But if there is any moisture whatever present in the tissue, it is subject to a curious phenomenon, first discovered by Sir William Abney, and known as "the continuing action of light." The action started by light under the negative proceeds in darkness, very much in the same way as if the tissue were still being printed. The result is, that a print half done, if put away for some time before it is developed, may be found to yield as vigorous a picture as it would have done had the printing been complete and development followed on at once. Where carbon printing is constantly being carried on, it has been found possible to take advantage of this continuing action to shorten the time of printing when the light is poor, but when using the process in a small way and at intervals, as an amateur does, this is too risky to be worth attempting; since the rapidity of the action varies with the temperature and with the degree of moisture present. When development has to be postponed, this phenomenon may give rise to trouble; and it is particularly prone to lie in wait for the skilful carbon printer who has accepted the invitation of the secretary of his Photographic Society to "come down some evening and give us a demonstration." He is in the habit of printing and developing in close succession, and either forgets all about the continuing action, or at least greatly underestimates it, and in the interval between printing in the daytime and development before the Society at night, the tissue has actually overprinted. It is a curious fact, and shows how persistent is the tendency to underrate this action, that the author, who has seen many such demonstrations, has hardly seen one in which the prints were not distinctly darker than was intended from this cause, and has certainly never come across a single case in which they were too light from excessive allowance having been made for the continuing action.

Up to the stage that we are now considering, the single transfer and the double transfer carbon processes are identical; but we are now at the point at which they differ, though only slightly. The reversal as regards right and left, which is the one drawback of single transfer, for many subjects is quite unimportant. In pictorial work generally its influence has never been carefully studied, and many photographers would say that provided the picture did not purport to represent any known

THE CHURCH OF ENGLAND

BY WALTER BENINGTON

subject with which it could be compared, and its reversal thus detected, it did not matter which way round it was. This does not apply of course to the case of portraits, in which this is very important, much more so than many think. If the wedding-ring is shown on the wrong hand, the observant eye of a lady detects it instantly, though without so self-evident a clue she might see the portraits of all her friends reversed right for left, and never detect that there was anything wrong at all: showing that her observation was superficial and limited, as indeed is that of most people. Any one who cares to take the trouble to study a face, as a painter has to do who would portray it properly, knows that the two sides of it are never alike. "Nature knows no equality," said an orator, "and the only equality possible artificially is in the voting power of St. Paul and Judas Iscariot in the ideal democracy." Without following him into politics, we may note that his sweeping generalization is true enough of the two so-called symmetrical halves in which the human being can be regarded; although the extent of the difference varies very much. Still there always is a difference, especially noticeable in the face, and a very little observation will show it. In landscape, too, the effect may be decidedly different in two pictures, identical in all respects except as regards this reversal of right for left; and the subject is one which might well receive the attention of a critic of analytical turn of mind. It would necessitate the careful study of a large number of pictures if any generalization of value is to be drawn up; for there has already been far too much verbiage on subjects of this kind that seems only to have been evolved from its writers' inner consciousness, and not based upon any thoughtful analysis of examples, which alone could give a result of any value.

While the single transfer process, if the print is made from a glass or film negative in the ordinary way, gives a reversed picture, there are several ways of preventing this from being a reversal of the original subject, without having recourse to double transfer. If the negative is on a film, printing may be carried on with equal ease, and with almost equally good definition from either side. All we have to do is to print in carbon from the opposite side of the film to that ordinarily placed next the sensitive material. If the negative is on glass,

it may be stripped therefrom, or "filmed" as it is called, and printed from the reverse side in the same way. If the negative is to be specially made for single transfer carbon, the plate may be put into the dark slide the wrong way round, with its glass side towards the lens; but this is rather a brutal proceeding. The exposure is increased, there is danger that the spring of the dark slide may injure the surface of the film, and a backed plate cannot be used, though this is only troublesome if the plate is already backed, as halation is not likely to arise, for obvious reasons. Then, again, the thickness of the glass is not precisely known, yet it must be allowed for in focussing—a thing generally done in a happy-go-lucky way by reversing the focussing screen. Last, but not least, any imperfection on the surface or in the body of the glass of the plate prints itself on the negative with the approximately parallel rays from the lens, though it might never show when printing in the ordinary manner in diffused light. A fairly good string of objections, surely! A much better plan is to employ a right-angled prism in front of the lens, which reflects the image, and in doing so reverses it. This is the method employed by process workers to obtain reversed negatives. If the prism is too costly, a piece of plate-glass, silvered on the surface, which can be got from a good optician comparatively cheaply, may be substituted with a fairly good result.

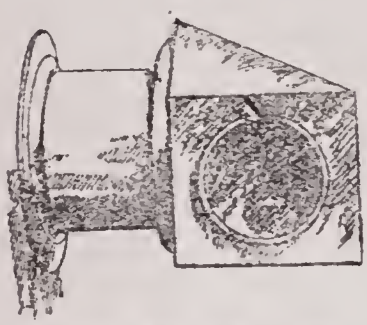


Fig. 18.—A Reversing Prism.

Single transfer paper of the thin smooth character generally used requires no preliminary soaking, but if a rough or thick paper is employed, it must be soaked for some time before use. Very rough papers should have at least an hour in cold water, or, if this is not possible, they should be put for ten minutes or so in warm water and then be transferred to cold. The whole secret of successful transferring lies in the selection of the proper moment at which to bring tissue and transfer paper into contact. Unless the tissue is quite dry when transferring is begun this moment cannot be ascertained properly. The print should feel quite stiff, or, at least, it should not be limp. A sheet of glass, or a board covered with a smooth piece of zinc, and a flat, not a roller, squeegee are the most suitable

BRIAR ROSE

BY J. CRUWYS RICHARDS

implements. The transfer paper, a little larger than the tissue, is placed, face upwards, on the bottom of a dish of clean water, and the piece of printed tissue is immersed in the same dish, and looked to that no air bells remain on it back or front. It will curl up with the coated side inwards for a moment, but very soon it will be noticed that the tissue starts uncurling. This is the sign that it is in the right state for transferring, and it must be at once arranged, face downwards, in position on the transfer paper, the two withdrawn from the water together, and laid on the glass or zinc. The squeegee is then applied vigorously, but not violently, in all directions, to bring the two surfaces without loss of time into close contact. If the operation has been carried out properly the tissue will go on absorbing water, will suck up all the thin film existing between its surface and that of the transfer paper, and will adhere closely to it. The operation need not be performed in a hurry, but it must not be carried out too deliberately, or the favourable moment will have gone by; and when once the tissue has fairly flattened itself in the water, it has absorbed as much as it will, and no degree of squeegeeing or of pressure will make it adhere. After squeegeeing, the two papers may be left for fifteen or twenty minutes on the squeegeeing board, or between blotters, or hung up, while preparations are made to develop the print.

Warm water is the only developing agent required by the carbon process, and the wonderful way in which under its influence the repellent black mass, which is all that is visible at first, gradually reveals a picture in all the gradations of light and shade, has a curious fascination for those for whom familiarity has not made the phenomenon seem a matter of course. There is no need to use a thermometer, as slight differences of temperature in the water do not make any very great difference in the result, but it is well not to have the water too hot to start with. It should feel agreeably warm to the hands and nothing more, and if this is examined with a thermometer it will be found to be from 105° to 115° Fahr., according to the callousness of the photographer. Before being at the trouble to develop a print it is well to make sure the tissue is in good order. In fact, if the tissue has been kept for more than a day or two after sensitizing it is a wise precaution to see that it is soluble, before being at the trouble to print on it. This is done

by taking a small strip, allowing it to soak in cold water for a minute or so, and then holding it so that half of it is immersed in the warm water. The gelatine and pigment will wash away leaving the paper support quite white, if the tissue is in good order.

The print adhering to its transfer paper is slid into the warm water, tissue uppermost, and left there for a minute or so. Before that time has elapsed, coloured gelatine will be seen to be oozing out at the edges all round, and this is generally taken as a sign that the paper may be stripped off. It is well not to hurry it, as nothing is gained by so doing, beyond the risk of pulling some of the image off with the paper, and so spoiling the picture. When there is no doubt about the dissolving action being general, one corner of the paper is raised and it is skinned off with a smooth unbroken pull, leaving a dirty-looking dark coloured mass on the transfer paper. The warm water may be gently splashed over this with the hand, or the print may be left undisturbed for a few minutes. In either case signs of the picture will soon appear, and it will become more and more visible by the washing away of the soluble pigment and gelatine. If the print is allowed to lie on the surface of the water, face downwards, it will gradually develop spontaneously; but if this method is adopted it is most important that there should be a good depth of water beneath it—enough at any rate to remove all risk of the face of the print coming into contact with the bottom of the dish, which would almost certainly injure it. Most carbon workers prefer to support the print, face upwards, on a sheet of glass and pour warm water over the face of it, there being a widespread belief in the power of modifying the tones of a carbon print by so doing. A stream of warm water is directed on to those parts which are to be lightened, avoiding the rest of the print. There is a slight power to be obtained in this way, but it is much overestimated as a rule, and if there is to be local alteration of this kind, the only method that is really satisfactory is by work on the negative, such as is discussed in Chapter XX.

It is not possible to stop developing a carbon print just when the vigour of the result seems to make it desirable, and the operation must be continued until most of the gelatine, which is still soluble at the temperature of the water that is

being used, has been removed. If this is not done, there is great risk of the surface being covered with greasy-looking mottling. At the same time, it is possible to control the strength of the image that shall be left, by the temperature of the developing water. With equal printing, the hotter the water the lighter and softer the resulting print. Over-printed tissue is therefore all the better for being developed in hotter water than usual, while under printing may be compensated to a certain extent by cooler water. It may happen that the development has gone far enough to prevent mottling, but the print is a little muddy in appearance. By drawing a tuft of cotton-wool over its surface while still under the water, a certain quantity of pigment and gelatine will be removed, as will be seen by looking at the wool, and the print will be cleared up a little. The same result can be obtained by the use of a camel-hair brush.

Any manipulation at this stage must be done with the utmost gentleness if the print is not to be ruined, and it should only be tried as a last resource, and on a print otherwise valueless. The thin film of gelatine on the transfer paper, especially in the highest lights, where it is of microscopic thickness only, is most delicate, and the slightest roughness will remove it and leave an unsightly mark. If the temperature of the water is too high there will be great risk of blisters on the prints. A safe rule is never to use water which is too hot for the hands. The developing water soon gets dirty, from the dissolved pigment, but this does no harm to the prints.

The carbon print when developed is virtually finished. Its appearance is almost that which it will have at the end of the process, and if it were hung up just as it is and dried, it would be permanent. It is customary to give the prints an alum bath after developing, as this has two advantages—it hardens the film, preventing accidental injury while drying, and it removes the slight yellow tint due to the bichromate, which is still to be noticed in the developed picture. A five-per-cent. solution of alum, best made by dissolving a couple of ounces of potash alum, the alum of the oilshops, in a few ounces of boiling water and diluting it to make a quart, is all that is necessary, and the developed print, having been placed for a few moments in cold water, is put into the cold solution of

alum, in which it may be left for anything up to an hour or more. The exact time is not important, provided the colour is completely discharged, which should be ascertained by holding the print up to the light and looking through it. It is then washed for a few minutes to get rid of most of the alum, and is hung up to dry.

Besides the very great range of colours which the carbon process enables us to use, there is almost as wide a range of paper textures. The tissue manufacturers supply a number of different transfer papers for the process, both smooth and rough, of varied tints and with varied grain. The Autotype Company have a great variety, and it is well worth the time of the enthusiastic carbon printer to find out precisely what transfer papers the company is in a position to supply at any particular time, over and above the ordinary kinds which figure regularly in its price list. But when all the commercial papers have been obtained, we are only on the fringe of the possibilities of carbon printing.

It is quite an easy matter to prepare any paper not absolutely rotten in texture, so that a carbon print may be developed on it. All that has to be done is to give it a sizing of gelatine of such a character that it shall not dissolve off in the warm water.

The simplest method of preparing transfer paper is that given in the "Autotype A.B.C." Two solutions must be prepared, one of an ounce of Nelson's No. 1 gelatine in a pint of cold water, dissolving by heat after allowing the gelatine to soften, and the other of twenty grains of chrome alum in two ounces of hot water. Both the solutions are made hot, and, the gelatine being stirred, the chrome alum is added a few drops at a time. The selected paper is immersed for a minute in the warm mixture, taking care to break air-bells which form, and is then hung up to dry. Or the gelatine solution may be spread over its surface with a brush or sponge, taking care to rub it well in, especially if the paper is a rough one. Another sizing solution which has been recommended for the purpose is made by boiling for half an hour or so, three ounces of shellac and an ounce of borax in a pint and a half of water. Shellac is not soluble in water, but will dissolve slowly in a hot solution of borax, and so will form a water-varnish, in which the paper

may be immersed and then hung up to dry. If a piece of some particular paper is wanted in a hurry for a single transfer, it may be dipped in one of the ordinary cold or celluloid negative varnishes and dried.

Tinted papers, if not too dark, form very effective supports for prints on carbon tissue, and their use has hardly been as extended as the facilities which they afford for certain effects might lead one to expect. Even brown paper, at times, gives very pleasant results, though the power which the crayon worker possesses of picking out his highest lights in white is one the carbon worker does not enjoy, and one whose absence limits the applicability of the deeper shades of paper.

Double transfer is not very extensively used by amateur photographers, but is more the process for the professional portraitist of the better class. The method does not differ very greatly from single transfer. The tissue, after being printed, is transferred, not to a final support, but to a temporary one on which the print is developed. The most convenient medium is Sawyer's "Flexible Temporary Support," a coated paper whose surface has to be waxed before use. It is best to buy the waxing solution ready made, but it may be prepared by dissolving six drams of yellow resin and two drams of pure beeswax in a pint of turpentine. A day before the flexible support is to be used, a little of the waxing solution is poured on to it and rubbed all over with a piece of flannel. With a fresh piece the support is given a final polish, taking care that it is not left in a streaky condition, and the support is then pinned up to allow the turpentine to evaporate. Or the waxing solution may, instead, be applied to the ground surface of a piece of fine matt opal glass. The opal or the flexible support is used exactly as the single transfer paper, and the print developed on it, washed, and alumed. The flexible support requires a longer soaking in alum to remove the bichromate stain than does the opal, but otherwise the treatment is identical. The prints may then be dried, or may be brought while still wet into contact with the paper upon which finally they are to rest.

The final support in double-transfer work, should have a thicker coating of gelatine than in single transfer, and is therefore best bought ready coated. It should be cut up into pieces

a little larger than the pictures on the opal or flexible support, but smaller than the support itself, and soaked for half an hour in a solution of half an ounce of alum in twenty-five ounces of water. It is then transferred to a dish of cold water, from which it is taken for use. A dish of water which is just warm is wanted for the transferring process, and the print on its temporary support of opal or paper is placed for a minute or so in this, the final support is immersed in it also, brought with its coated side in contact with the print, and the two are brought out together, laid on a flat surface, and gently squeegeed. If opal is used, it is well to put it away under gentle pressure for twelve hours, with some blotting-paper lying on the print, but if a paper support is employed it may just be hung up to dry. After twelve hours, the opal is allowed to finish drying in a vertical position or in a rack, and when dry the finished prints should fall off it without stripping. If not, and one is quite sure they are dry, they may be coaxed off by raising one corner with a pin. There should be no trouble at all in stripping prints from flexible support ; the opal gets better with repeated use, if it is waxed but is not washed between each. The flexible support may also be used over and over again, and if for any reason a print on it is spoilt, it is good economy to transfer it to a final support all the same, as this is the best way to clean the temporary support ready to use again.

Prints on flexible support, when transferred, have a fine glossy surface almost equal to that on glossy P.O.P. If the matt opal is used, the surface is not so shiny. In either case, if there is any dulness of the surface it may be removed by gently rubbing it with a piece of flannel moistened with methylated spirit or with benzol.

The subject of printing in clouds is dealt with elsewhere, but there is a method of doing so which is only applicable to the carbon process, and therefore is more conveniently considered here. In this method, the landscape is first printed, transferred, and developed. The clouds are printed to the requisite depth, the tissue being marked so that the position of the clouds and skyline on it may be known thereafter. This may be done in pencil on the back. The landscape print, having been alumed, washed, and dried, is allowed to soak in

WASSILI SAFONOFF

BY FURLEY LEWIS

water exactly as if it were a fresh piece of transfer paper, and the cloud tissue is squeegeed down upon it in the position desired. Pencil-marks on the margin of the landscape print make this process easier. The clouds are stripped and developed in the usual way, and when the cloud-picture has been brought to the right depth, a fine brush with stiff hairs—a sable does very well—is employed to remove the image of the clouds from those parts where it unduly overlaps the landscape print. With care this can be done to conceal all junctions whatever, so that the clouds and landscape show no trace of their separate origin, provided of course, always, that they do not give the secret away by their incompatibility.

The spotting of a carbon print is best done by taking a little strip of the tissue while it is still soluble, dissolving it in hot water, and putting it aside in a tall vessel to settle. If it is left a week or two all the better. The water is then poured off as closely as possible, leaving a little pigment at the bottom, which may be mixed up with a little gum and employed with the certainty that in colour it is a perfect match with prints on the same tissue as that which yielded it.

There is only one other modification of the carbon process that need concern us here, and that is the development of carbon prints on plain glass for transparencies. This has a twofold application. The transparencies may be used for ordinary purposes of decoration or for lantern slides, or may be backed up with suitable material and framed just as if they were paper pictures, and they may also be used as the means of duplicating negatives either the same size as the original or larger. It is, unfortunately, only too obvious to those who attempt it, that in making a positive from a negative on an ordinary gelatine plate, whether by contact or in the camera, and then making a fresh negative from that positive by a repetition of the process, there is a very serious falling off in quality. This is always seen to take the form of a falsification of the intermediate tones of the picture, and theory shows us that it is inherent in the dry-plate process. This falsification does not take place in carbon printing, and we may therefore make a positive transparency on glass by means of carbon, and from that make any number of carbon negatives, which, with proper precautions, may all be identical in character, and, what

is more important still, may be faithful transcripts of the original negative. Such negatives will be practically the same size as the original, though, in consequence of the expansion of the tissue, they will not be quite accurate in this respect. If we want an enlarged negative, we are bound to use a dry plate, but we may at least use the carbon method either to make a transparency by contact from which to enlarge, or to make a contact negative from the enlarged transparency, and in so doing we get rid of half the inherent falsification which we should get by employing the dry plate both for transparency and negative. Valuable negatives, which cannot be replaced, or at least which can only be replaced with great difficulty or expense, should always have a carbon transparency made from them before they are printed in any other way or exposed to risk of damage. It costs little, it is very little trouble, and is a guarantee that if anything should happen to the negative it can be duplicated.

The process of making glass transparencies in carbon is very similar to that of making prints, but certain precautions have to be taken which are not necessary when the prints are being made on paper. The glass must have a preliminary coating of gelatine, to ensure the adhesion of the film. After thorough cleaning with soap and water, followed by rinsing, the glasses should be immersed in a solution made by dissolving six drams of Nelson's No. 1 gelatine in a pint of warm water, and adding enough bichromate to give the solution a sherry colour (Autotype formula). This should be filtered while warm through a tuft of cotton-wool, and if, on taking a plate out of it, the solution seems to run off it as if the surface were greasy, the plate must be rubbed with a clean flannel dipped in the gelatine until it is seen that its surface is thoroughly wetted. The glasses are then placed in a rack to drain and dry in daylight, so that the bichromate may make the thin gelatine coating upon them insoluble. The author has succeeded in making some very good carbon transparencies by coating the clean dry glass with ordinary celluloid negative varnish as a substratum instead of gelatine. The varnish seemed to hold the tissue equally well, and, contrary to expectation, did not show any sign of stripping off the glass when this was placed in warm water to develop the picture.

If the exposed tissue is collodionized before applying it to the glass, it is a little extra trouble, but this is always repaid in quality. To do this, the piece of tissue must be at least a quarter of an inch larger on all sides than the negative, and after printing this edge is turned up, and the tissue fastened to a flat piece of wood with four pins, one corner of the tissue overhanging the wood. Some enamel collodion is poured into the flat dish thus formed, and after tilting it so that it will flow all over, is poured out again and the tissue stood up to dry, which it will do in a few minutes. This must be done in very weak daylight or by artificial light, not too near a naked flame, as the ether in collodion is very inflammable. When the coating is dry, the print is immersed in water and transferred to the glass just as to a piece of transfer paper. The squeegeeing must on no account be violent or the transparency may be marked. Undue pressure in the printing-frame may also cause marks, especially if the tissue when in the printing-frame is at all limp. If the carbon transparencies are to be used for enlarging, these marks are comparatively unimportant, as even in very bad cases they may be quite invisible on the enlargement, but when the transparencies are to be viewed direct, they must be avoided.

A good many amateur photographers seem to shun the carbon process because of a mistaken impression as to its difficulty. This is due in a great measure to the unfamiliarity of the processes by which a carbon print is made, differing so very greatly from those of other printing methods. When they do not allow themselves to be daunted by imaginary obstacles and plunge boldly in, they are surprised at the ease with which carbon prints can be made, and particularly at the absence of mysterious defects. There is very little that can go wrong in a carbon print, and if anything does help to make it what it should not be, the cause is generally easily detected, and precaution taken against it in the future. The sensitizing bath must not be too strong, nor must it be too warm. In very hot weather it may be necessary to put a lump of ice in it to prevent the soft gelatine of which the coating on the tissue is composed, from actually dissolving in the solution. Such a precaution is very rarely needed. The point where there is most often error is in selecting the wrong moment for

taking tissue and transfer paper together out of the bath for squeegeeing into contact. We had written that "is where there is most risk of error," but really there is none. The tissue curls up, and then commences to uncurl, and the first unmistakable sign of that uncurling is the indication that the moment has arrived. If the tissue neither curls nor uncurls, it is too damp altogether to use, and should have been dried more thoroughly. If it has become insoluble in warm water, it will not adhere at all; but then, as if it did it could not be developed, this is hardly a defect, but a virtue, saving transfer paper, tissue, and temper. If it has not been properly squeegeed, the finished print may show tiny bright specks on its surface, where little air-bells have prevented perfect contact between the tissue and its final support. Before immersing transfer paper in the water, it will be found helpful to scribble in pencil on the back, to show that it is the back. Otherwise on coming to use it when wet, it may not be possible to tell back from front.

One word of caution may be added before we leave the subject of carbon, and that is with reference to what is called the bichromate disease. Bichromate, although it is not scheduled by Parliament as a poison, is so regardless of that august body as to be fatal to any person who attempts to use it as food, even in very small quantities. Still, in this respect it is no worse than most of the chemicals used in photography. It is, however, particularly injurious if it can find a cut by which it may enter the system, and those who are constantly using it are liable to skin trouble of a serious kind in consequence of its absorption by the pores. Used in a small way, as is the case with amateur carbon workers, it is quite harmless, provided there are no cuts on the hands, and provided also that a reasonable degree of cleanliness is maintained, the nails being brushed with soap and water after the fingers have been immersed in bichromate solutions for any time.

One of the most curious characteristics of the carbon process is the property which a printed piece of tissue possesses of transferring its image to an unexposed piece of tissue with which it has been kept in contact for a little time. This property was the basis of two processes entitled "Mariotype," from M. Marion, who introduced them over thirty years ago; they have long since been obsolete. Although differing very

SNOW

BY ROBERT DEMACHY

widely from Mariotype, Mr. Manly's "Ozotype" seems to take advantage of some similar phenomena; but although its practice is simple enough, opinions are divided as to the nature of the chemical change underlying ozotype.

In ozotype, well-sized paper is sensitized by the application of a solution containing both potassium bichromate and a manganous salt, and when dry this paper is printed under a negative in the usual way, the result being a visible but faint image. As soon as possible after printing the paper is washed in several changes, or in running water, until its imprinted edges are quite white, when it may be allowed to dry. In this condition it may be kept for a long time, many months in fact, although it gradually alters. The final stages of making the print can therefore be deferred at will. They consist of the immersion of a piece of insensitive carbon tissue in a solution which contains copper sulphate, hydrokinone, and acetic acid, and when the tissue is limp, the immersion of the print also, which is placed with its face in contact with the tissue, the two being then withdrawn, and squeegeed into contact. After the lapse of a certain time, during which the image on the print is acting on the pigmented gelatine of the tissue, the two are placed in warm water, the backing paper is stripped off, and the "carbon" image developed on the surface of the original print.

As the process is a patented one, there is no need to go into its manipulations at any length. It is claimed for it that while there is all the range of colour and surface and the permanence of a carbon print, ozotype has the additional advantages of a visible image as a guide in printing, of no second transfer to avoid reversal as regards right and left, and of no need of a safe edge. On the other hand, the process is distinctly more complicated, and there seems to be no doubt that in the great majority of cases there is a decided loss of definition, although this is not of necessity a drawback. In spite of its ingenuity, it has never become a popular process in any sense of the word, though its inventor, Mr. Thomas Manly, has striven hard to make it so.

One modification of "carbon" which, until the advent of "oil" and "bromoil," was very popular for exhibition work, is gum bichromate, called affectionately by its adherents and

derisively by its opponents "bi-gum." It is supposed by some to be incapable of rendering detail, by others to be inseparable from a coarse granularity, which has been compared to cocoanut matting; but these characteristics are by no means inherent in it, however they might have been in the results of some of those who used it. The pictures of some of its most skilful practitioners, such as Mr. Cruwys Richards, M. Demachy, and Mr. Mummery, to name but three, revealed none of this texture, and in their way were often indistinguishable from platinotypes, except by the power of control over the result which the producer was able to exercise. Perhaps we cannot do better than let Mr. Mummery, who identified himself with the process as its most successful British exponent, tell of it in his own words:—

"Of all the printing methods which are at the disposal of photographers," he wrote to the author, "that known as gum bichromate is essentially the process of the amateur; of the individual who works for the love of the work. Its capacity for responding to the personal feelings of the worker, and its flexibility in his hands, are at once the charm and the difficulty of the process. The charm is felt as the worker is led to a new and extended view of photography and its possibilities as a pictorial art; and although the chemical reactions are just as uncompromising as in any other process, if a little less certain, and all the old methods of printing by combination, masking, shading, etc., may be employed, yet there comes a point when the gum worker makes a new departure of his own.

"In most of our processes, when the print is ready for development or toning, its fate as a picture is already decided —the previous labours have been satisfactorily performed or they have failed, the developer merely confirms this; but in the case of gum printing the development becomes the opening of fresh opportunities for direct selection and modification. It is at this period that the personal factor becomes paramount, and the print, now visible and right-handed, may be considered in its artistic aspects, and treatment adopted to suit the requirements of each particular case.

"It may be thought the labouring of this point in the

practice of the process is unnecessary, but in reality the preparation for this after treatment is the key to success, and must be borne in mind from the beginning. The mere manufacture of a print in gum without taking advantage of its special characteristics, in most cases will only yield a result which can be better and more easily obtained by other processes, and will cause disappointment to the producer. The personal control to be exercised is purely a matter of taste, and cannot be described by formula, but must be left to be dealt with as the cases arise; and the necessities and aims of each worker, if seriously followed, may be trusted to develop a suitable technique. All the formulæ and methods described are open to wide modifications, and should be considered as standards from which departures may be made.

"Bichromate salts in the presence of a colloid substance (gum, gelatine, etc.) are sensitive to light. Not only is a visible image formed, but the parts more or less affected by light are rendered more or less insoluble in water; and beyond this, again, the film will absorb water, and swell in an inverse proportion to its exposure. This swelling and the formation of a raised and sunk image is an excellent guide to the condition at the time of development. In the early days of photography much effort was directed to the working out of a satisfactory printing process on these lines, and Mr. Pouncy, of Dorchester, discovered that by the use of gum as the colloid, mixing it with pigment, he could obtain a satisfactory image on paper. He published the particulars in 1858, under the name of 'Pouncy's Carbon Process.' His method, however, was obscured by the further perfection of what is now known as the carbon process, and it was not until 1894 that it was seriously revived and further developed by the application of after work; and, later, by the use of multiple printing.

"The practice may be divided broadly into two methods, commonly known as 'multiple printing,' where the picture is built up by two or more coatings and exposures; and 'single printing,' where the full effect is attained by one coating. Each has its own special qualities. The single printing yields freshness, brilliancy, and spontaneity; multiple coating, the opportunity for correction of the values—greater finish, the use of various colours, and ease of manipulation in large sizes. The

procedure in both methods is very similar, but to prevent confusion, it may be convenient first to describe multiple printing, and afterwards to point out the difference in the single method. The materials and apparatus are few and simple, and the description will be limited to those not usually found in the photographer's outfit.

"A very wide choice is open in the selection of a paper. Almost any surface, weight, colour, and quality are available, so long as the sample is well sized; but if an absorbent paper is employed it may be necessary to give it one or two coats of size, in order that the pigment may be retained upon the surface without sinking into the texture and degrading the high lights. With a hard sized paper this is not likely to occur unless the solution of gum is very weak or in bad condition. Either of the following preparations may be brushed over the surface to size it if required:—

3% to 5% of gelatine in water, with five drops of formaline to the ounce, or
½ oz. of Bermuda arrowroot to 16 ozs. of water mixed cold, boiled until it thickens, and allowed to cool before use.

"Such papers as Whatman's, the old water-colour paper, and the Arts Company's hand-made and machine-made drawing papers, Joynson, Michallet, and many cartridge and letter papers are not likely to require any additional sizing. Another point to be kept in view is the capacity of the paper for returning to its original dimensions after prolonged wetting, as failure to do this will affect the registration in after coatings.

"For the gum solution ordinary gum arabic in tears and free from adulterants is quite as good as the selected colourless gums. The solution may be prepared by placing, say, 2 ozs. of gum in the centre of a piece of clean linen, with the margins tied up in the form of a bag. The whole is suspended in 6 ozs. of cold water, contained in a wide-mouthed bottle. The gum will dissolve out in about two days, when the bag containing the refuse may be thrown away, and the gum is ready for use. The solution should be kept well corked: it will gradually become acid; but this is no defect so long as it does not proceed so far as to render the solution thin and watery. The proportions given yield a 33 per cent. solution, which is about the weakest gum it is desirable to employ. It will be found

A ROAD IN THE FENS *(ONE COATING)*

BY J. C. S. MUMMERY

easier to lay evenly than a more viscid solution, but will require at least two coatings to get transparency in the shadows. The strength may be increased to anything up to 50 per cent., and richer darks will result; but the beginner, at least, may find a difficulty in laying the coating as thin as it is desirable.

"The bichromate solution may be simply a saturated solution of potassium bichromate. The amount of the salt in the coating affects the rapidity of printing very materially; the solution should, therefore, be kept in a warm place and fully saturated. Ammonium bichromate may be used if preferred. It is more soluble and quicker in printing, but harder and more refractory in development; it is, however, useful if a fractional method of development is adopted.

"The pigments employed may be obtained from an artist's colourman, in the form of powder colours or moist colours in tubes or pans. The former can be bought by the ounce, and will require a short grinding with the gum to obtain an intimate mixture; they are thus more troublesome to mix, but are more easily measured, than moist colours. Such colours as lamp and ivory black, light red, burnt sienna, the browns, and many others are suitable; but the browns will work more readily if compounded of black and red or burnt sienna. For moist colours Schoenfield's Tempera colours and the Syntonos colours are less costly than ordinary colours, and will work excellently.

"An ordinary camel or bear hair mop is required for laying on the coating, one in which the quill holder is about $\frac{3}{4}$ inch in diameter will be found a suitable size; and a 4-inch hoghair grainer's softener will serve for smoothing the coating and removing inequalities, also some small camel hair and sable brushes for working upon the face of the print. Other accessories are: a small drawing board upon which to coat the paper, drawing pins, a piece of ground glass as a grinding slab, and a small glass muller, dishes, graduates, saucers, a palette knife or thin cheese knife, an actinometer for printing, and some muslin for filtering.

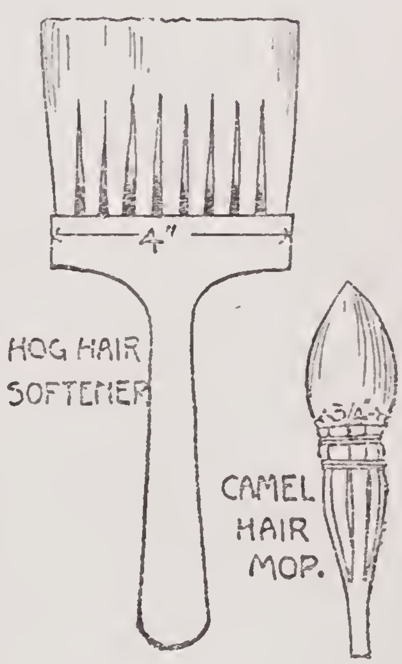


Fig. 19.

"To prepare the mixture for coating, we may take, say, 54 grains of ivory black in powder, 1 oz. of the 33 per cent. gum solution, and 1 oz. of bichromate solution. This will give an extremely thin coating of a warm black. Should lamp-black be substituted, 18 grains would give an equivalent depth of colour, but in the case of colours of lighter hue more pigment would be required. Placing the powder colour upon the glass slab, a portion of the gum is poured on to it, and with the knife the whole is mixed to a paste, and is then ground with the muller for two or three minutes to secure an intimate mixture. Having done this we can lift the mixture from the slab to a saucer by means of the knife, and, adding the remainder of the gum, stir the whole well with the mop brush (which should have been soaked to swell the hair). The bichromate solution is added, and the mixture is again stirred, and is then transferred to a measuring glass. From this it may be filtered through one or two thicknesses of muslin into a second glass, and poured into a clean saucer. It should now be limpid, free from dust, and ready for use. If moist-tube colours are used, the grinding and filtering are not necessary.

"To coat the paper, a sheet of absorbent paper (newspaper will answer the purpose) is placed on the drawing board, and upon this again the paper to be coated is placed, the whole being secured with four pins at the corners. Then, taking the mop brush, and stirring the mixture well, wiping out the surplus liquid against the edge of the saucer, we can proceed to paint over the paper with long horizontal strokes, dipping as required, and using as little of the mixture as possible. As soon as the horizontal strokes are completed, we can go over the surface with a series of vertical strokes, without adding any more of the mixture. Then, taking the softener and holding it quite vertically, with only the ends of the hairs touching the surface, a series of horizontal and vertical strokes must be given until the coating lies quite even. The small ridges left by the hairs will disappear as the coating dries. The whole operation should be done in from 40 to 50 seconds, as the coating rapidly hardens, and must not be dragged. It is essential to keep the mixture in the saucer well stirred, and to take up as little as possible upon the brush.

"The coating will harden in about half an hour; it should

A ROAD IN THE FENS *(TWO COATINGS)*

BY J. C. S. MUMMERY

then be thoroughly dried in a very warm room, or over the plate rack of a kitchener when the fire is low, and if placed forthwith in a calcium tube will remain unhurt for some weeks, although it is always better if used fresh. The surface of the coated paper should be slightly glossy, and, if unexposed and fresh, should lose the whole of its coating if soaked in water for thirty minutes. The brushes must be carefully washed after coating, as if allowed to harden they will be spoiled. The paper is not sensitive to light till dry. After printing, developing, and drying, additional coatings may be laid over the image in a similar manner, and local coatings may be applied to small spaces only if such are required.

"The negative best suited to the process is one which is thin, clean, justly exposed, and without violent contrasts. The printing may be performed in an ordinary pressure frame; but for multiple printing some contrivance must be devised for replacing the negative and print in exact register for further printing. This may be achieved by printing upon a drawing board, upon which the paper is laid face upwards, and upon this the negative film downwards, an ink line being drawn on the paper round the edge of the negative with a ruling pen. Or a simpler method may be adopted, by screwing wooden fillets to the face of the board along two adjoining edges at right angles to each—say, at the top and left-hand edges. The paper is then pushed up into contact with the top fillet, and slid along until it touches the fillet on the left; the negative is then treated in a similar manner, and a piece of plate glass laid over the whole will keep all in position. By this arrangement the paper and negative may be removed and replaced in exact register as often as required; and if two

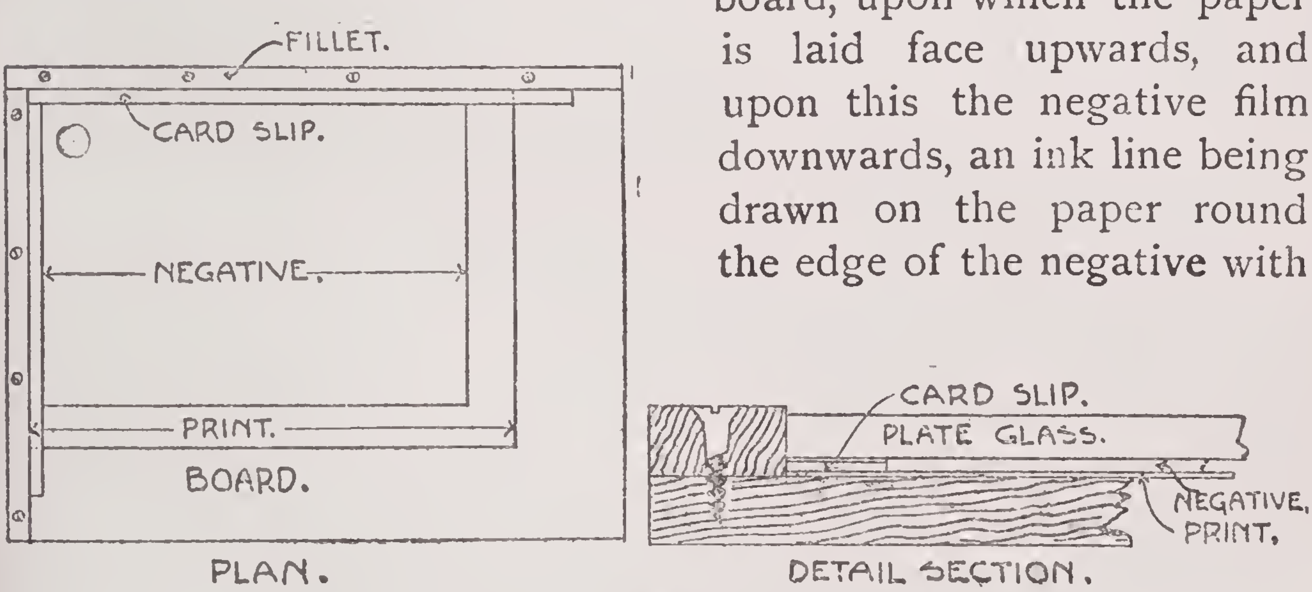


FIG. 20.

strips of card, cut with parallel sides, are introduced between the edges of the negative and the fillets, as shown in Fig. 20, the print will be brought away from the edge of the paper, which is desirable, as the edges are usually somewhat imperfectly coated.

"The exposure for paper prepared as described will be considerably less than for P.O.P.; and, as a rough guide, a piece of P.O.P. may be exposed under the negative until it looks correct in the frame. The exposure given to this, measured by tints upon the actinometer, will give an approximate exposure for a spray development.

"A thick coating, or a coating with more pigment in its composition, will require longer exposure. The visible image being too feeble and indistinct to act as a guide to exposure, the actinometer must be relied upon, and the utmost care taken to avoid over-exposure, which gives a dull and lifeless image. Printing must not in any case be done in direct sunlight, and when exposure is completed the paper must be kept perfectly dry until development.

"There are a variety of methods available for development, each yielding its own particular effect. The simplest is perhaps an automatic development, followed by after work, which may be practised as follows:—

"The print is placed face upwards in a dish of cold water until it is seen that no air-bells adhere; it is then turned gently over, face downwards, when, if the paper is in good condition, and the exposure has been well timed, the superfluous gum and pigment will gradually fall away, leaving the picture visible. It may now be taken from the water and placed face upwards upon a sheet of glass; and the pigment further washed away from large areas by pouring water very gently upon the glass margin, directing its flow over the portions of the print it is desired to lighten. By the use of a small sponge charged with water, and held in the hand just above the surface, drop by drop may be squeezed out over isolated portions and development so continued, keeping a cushion of water upon the surface of the print to soften the effect of the drops. When the most obvious local modifications have been made by these means, the print may be returned to the water until the general development has proceeded far enough.

"If the paper is not fresh, or is over-exposed, the print may refuse to develop as far as required; in this case resort may be had to water at a higher temperature, or even in refractory cases to the addition to each pint of hot water of a small piece of caustic soda of the size of a pea, but this should not be necessary. When the print has washed away to its proper strength it may be taken from the water, laid upon a sheet of glass, and stood up vertically to dry. This it will do without much loss of brilliancy if the exposure has been correct, and as the gum tends to get dry and firm, high lights, which show the white of the paper, may be picked out with a sable brush, and the drying completed in the dark. When dry, the print may be moistened in water and worked upon to any extent with brushes and stumps, modifying not only small details, but broad areas if required. This method requires much delicacy, and perhaps is better suited to single than multiple printing; the gauge of correct exposure is, that the print dries without running and without losing brilliancy.

"A simpler and less perfect method of development is by a fine rose connected by a rubber tube to a water tap, the spray being directed over the face of the print. Here a longer exposure will be necessary, and the print should only be just wetted before commencing to spray.

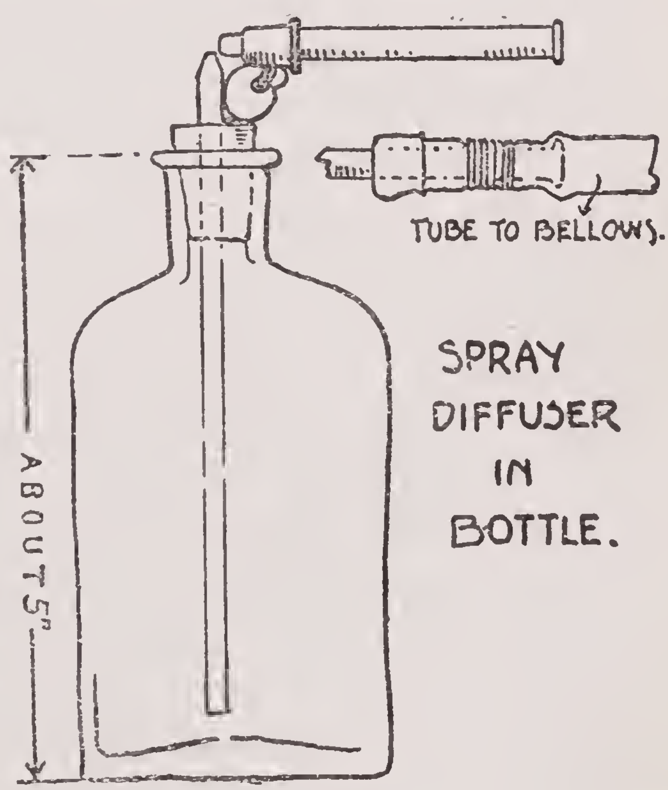


Fig. 21.

"A method of giving either a delicate or drastic development at will is by the use of an ordinary spray diffuser, as used for fixing drawings. It is inserted in a cork and used with a bottle of cold water, the print being arranged on a sheet of glass in a vertical position. The spray, consisting of fine particles of water, is blown upon the face of the print, and varies in strength with the power employed and the distance of the nozzle from the surface. In small sizes the spray may be

operated by the mouth, but more convenience is obtained by the use of 'Fletcher's Bellows' (No. 3 being a suitable size); this is connected to the spray by a $\frac{1}{4}$-inch rubber tube, and worked by the foot. The exposure here must be nicely adjusted to the spray, and will be slightly longer than for the automatic method described; the print should not soak for more than one quarter to a half minute before being subjected to the spray. If under-exposed the pigment will be washed away, and if over-exposed further soaking must be resorted to; in either case the result is defective.

"Development by the direct application of brushes or cotton wool whilst the print is in the water is possible, but is open to the objection that the exposure required for such rough handling is necessarily long, and the quality of the print suffers thereby.

"The print should always be stood up to dry vertically upon a sheet of glass, and not laid flat; and the perfection of richness is obtained when the print is in such a condition that it will only just dry without further running. This condition is purely a matter of correct exposure.

"After any of these methods of development the print may be dried in the dark and afterwards wetted and again worked upon, and specks of dust may be lifted from the print during development by means of a fine-pointed sable brush.

"When the first coating and printing has been completed the print may again be coated, and the whole process gone through as before for the purpose of strengthening the picture generally or in parts, obtaining greater or less contrast, or giving transparency, etc. The illustrations show the appearance of a picture as developed by the spray diffuser after the first and second printings respectively, and although they hardly show the extent to which modification has been effected, they at least indicate how the image is built up, and how the effects of solidity and distance may be obtained.

"The yellow bichromate stain, if present, may be removed at any time by soaking the print in a 5 per cent. solution of potash alum or sodium bisulphite, and afterwards rinsing it; but this treatment is best left until the final printing is completed, as it will cause a slight contraction of the paper.

"It will be seen that in multiple printing there is

opportunity for many modifications. For instance, with a dense negative a thin coating may be first applied and exposed very fully to obtain the image from the densest parts of the negative, and afterwards a thicker and darker coating with shorter exposure may be given for rendering the thinner portions. Or it may be desirable to give a coating with little or no pigment, to give a richness to the print; or, again, the field is open for printing in two or more colours and for many other variations which will suggest themselves to the worker.

"The description I have just given will apply also to single coating, but as the final strength is to be obtained in one operation the following modifications are desirable: The solution of gum should be 45 to 50 per cent., preferably the latter, and with this 60 to 66 grains of ivory black, or 20 to 23 grains of lamp-black to the ounce of gum solution should be added. The additional thickness of the gum will render the coating somewhat difficult, and care must be taken to lay it as thinly and quickly as possible. The exposure with the thicker coating may be somewhat longer.

"In development, although it is possible to use the spray, the automatic method followed by after work is par excellence that for single coating. To obtain the richest and most perfect single prints the paper must be quite fresh, say not more than two or three days old. The negative must hold the correct range of tones for the paper, and the exposure must be quite correct."

OIL PRINTING AND BROMOIL

When this book was written the gum-bichromate process, as Mr. Mummery has just described it, was the most prominent method of the exhibiting photographer. Not that it was ever used by a majority; "bi-gums," even when at their highest, were only in a comparatively small minority at the leading shows; but the process was that which was used by the most progressive workers, and for the most discussed exhibits. The fourteen years that have elapsed have seen it entirely supplanted; until now the gum-bichromate prints at an exhibition are the most obscure and insignificant. The rival which has dethroned it is known as the "oil" process,

with an allied method known as "bromoil," which is a hybrid between the ozotype already referred to and the oil methods.

Oil printing is based upon one of the earliest photographic methods, one of the many applications of bichromated gelatine. Amongst the other alterations which the action of light brings about in a film of this nature is this—that if the film after exposure is soaked in water for a sufficient length of time and then blotted off, those parts where the light has acted will retain a greasy ink, such as printing ink, if a roller or brush coated with it is passed across the film, while the parts which have not been exposed to light do not retain it. The principle is the basis of the collotype process, as we shall see later on. The great value of the oil process in the hands of the skilful manipulator is that it allows him to apply more of the ink in the parts which he wishes to tone down and less in those parts he would keep light. It is thus the reverse of gum bichromate; in the latter, starting with a sheet of paper evenly coated with pigment, this is removed whence it is not wanted to form the picture, while in "oil," starting with a clean sheet of paper, pigment is only placed where it is wanted. In the latter, also, we have this peculiarity—that if the pigment is applied anywhere in error, it is easily removed and the work done over again.

For printing in oil, paper coated with a layer of soluble gelatine is required. Special papers are made for the purpose, but some of the most successful workers have used the "final support" made for double transfer carbon. Autotype oil printing paper is very popular for this purpose. The paper is sensitized either by immersion in a solution of bichromate or by brushing a solution over the surface. A very convenient method is to use a mixture of equal parts of methylated spirit and of a 10 per cent. solution of ammonium bichromate. This is applied with a "Blanchard Brush," which is simply a strip of glass with a piece of flannel or of swansdown folded smoothly over the end of it and held in place with a rubber band. A very little of the solution is taken up with the brush, and this is drawn across the face of the paper, first in one direction and then at right angles to it, until an even yellow tint is given to it and the brush seems to drag slightly. The paper is then dried in the dark, which, if the sensitizer

contained spirit, will only take a few minutes. It can be kept in a sensitive condition for a few days; but the sooner it is printed the better.

Such paper is printed by daylight, a visible image being obtained, which is useful as a guide to the depth of printing, the correct depth of printing being very important. The paper is very sensitive to light, much more so than P.O.P., and should therefore only be exposed very cautiously when it is being examined in the printing frame. When printing is complete every tone that is to appear in the finished print should be visible; but over-printing makes it impossible to get good bright high-lights. The negative that will give a good print on P.O.P. is that which is most suitable for oil-printing; and owing to the degree of control which can be exercised when applying the pigment, there are wide limits within which negatives may vary. As soon after printing as possible the paper must be placed in clean cold water, which should be changed two or three times to get rid of the bichromate, and it is then left to soak for from half an hour upwards. It is best to continue the soaking until the image is almost invisible again, or at least until all trace of yellowness has gone out of the whites. When this stage is reached, the print may either be inked up forthwith or it may be dried and put on one side until the inking-up can be put in hand. It will keep quite indefinitely, and is no longer sensitive to light.

An oil print to be inked up must be fully charged with moisture. For this reason it must be soaked for some time, an hour is none too long if it has been dried after printing. It must be kept moist while it is being inked, so that it is laid on a wet pad of a few sheets of blotting paper, on top of which a piece of muslin may be placed. As it is difficult to carry the pigmenting right up to the edge of the paper, it is convenient to mask the negative, or at least to make the print on paper a little larger than the finished picture is to be. It is laid face upwards on the pad provided for it, and the surplus water is wiped from the face with a pad of soft muslin. The image at this stage will not merely be faintly visible in a drab-grey colour, but will probably also show some signs of relief, at least along lines bounding strong contrasts.

The inking-up may either be done with the inks made for lithographic work, which were used by the pioneers of the process, or the special pigments which are now made for the purpose can be used. The latter are to be preferred, as they are of suitable consistency for use as they are, without the addition of any medium, and the correct condition in this respect is of great importance. They are applied to the print by means of brushes, and these, which for the best work must be of a particular kind, constitute the most expensive item of the equipment, a large one, which is necessary for the general work, costing from 5s. upwards. These bushes are known are "pied de biche," and have the ends of the fine hair of which they are composed finished off in a slightly convex form, which in the most suitable pattern is inclined slightly to one side: one or two smaller brushes with flat ends rather than of the skew shape are also needed. The other materials include an old negative to act as a palette, and a palette knife.

The pigmenting or inking-up of an oil print is a very interesting process. A little of the ink being spread out in a very thin layer on the glass, the tip of the brush is touched on it very gently two or three times, and is then dabbed very lightly on a clean part of the glass. The touch can hardly be too delicate, the hairs being only slightly bent with the pressure, and a fine deposit of the pigment with an imperceptible grain should be all that is left on the glass to show where the brush touched it. In this condition, holding the brush vertically and by the tip of the handle, it is lightly dabbed on the print, in the way just described. If the exposure has been correct the result of a very few such touches will be seen in the image on the paper becoming gradually more and more distinct. The whole surface is gone over like this, taking fresh pigment from the glass from time to time, and evening it up on the brush by dabbing it on the glass before applying it to the print. Dabbing is almost too strong a term for the very light touch that is required. With each application of the brush more and more of the pigment will be taken up by the paper, and then, by continued working over the surface, this pigment is distributed more and more in proportion to the light action. So that a surface which

MONTMARTRE

BY C. PUYO

when first gone over with the brush seems to take the pigment more or less all over, as the dabbing progresses will be found gradually to lighten in the parts where the light action was least, and to darken where it was greatest. An alternative method of work with the brush is known as "hopping." In this the brush is allowed to fall vertically on the paper and as the elasticity of its hairs cause it to rebound is caught on the rebound and dropped again. A wire holder with a handle can be purchased which allows this hopping to be done without so much fatigue and very quickly.

The action of the brush is a peculiar one, and is paralleled by the action of a roller in collotype. If the brush is very quickly and lightly touched on the print, or, in the latter process, if the roller travels very quickly over the surface, it removes the ink already there; if the action is slow and heavy it deposits the ink everywhere, both where it is wanted and where it is not. The happy mean is that which must be aimed at, if the oil print is to be a faithful transcript of the negative. Although it is possible by such modifications of touch to cover the print with ink and then to remove the whole of it, all expert opinion on the oil process is in favour of only applying the ink where it is wanted, getting first a faint image over the whole print and then building up on that. The pigmenting usually takes from five minutes to half an hour, according to the size of the print and the degree of work to be done on it. If during that time there are signs of the paper taking the ink where it should not, it may indicate that the paper is getting too dry and it must be resoaked. This should not be necessary when the time of inking-up has not exceeded half an hour. The contrasts of the print should be left a little stronger than seems best at the time, as it dulls down on drying.

After the oil print has been pigmented it is finished. All that remains to be done is to pin it up out of the dust to get dry and to allow the ink to harden. It is best to leave it a few days, or the pigment may be rubbed; but after the lapse of that time a gentle rubbing of the surface will remove any hairs or other foreign matter, any spots may be carefully touched out and the picture is ready for mounting. A cut-out mount is best, if it is not to be framed, as this protects the surface from rubbing.

Prints made by this process can be inked up in any colour which can be ground up with oil; but engraving black is the best to use at first, as with strong colours there is a difficulty at times of getting sufficient depth. The black will look an olive black when on the paper, if much of the original image was visible when the pigmenting was put in hand. Mr. Wastell points out that this can be got rid of almost completely by placing the prints, after they have been washing for an hour, in a 5 per cent. bath of sulphuric acid for a minute or so, and then giving another half-hour's washing. As the acid tends to soften the gelatine, prints which are treated with it should not be inked up forthwith, but should be allowed to dry and then resoaked. The brushes used should be cleaned as soon as work is over by rinsing them in petrol. A print which is not satisfactory can have all the pigment washed off with a little petrol, and may then be soaked in water and pigmented afresh. Mere soaking in water and gentle rubbing will remove a good deal of the pigment; but the petrol method is to be preferred.

Many of the oil prints which are shown at exhibitions are coarse and granular in character, and leave very much to be desired in the way they reproduce the tones and the details of the negative; the process has suffered in repute, because many have come to the conclusion that these defects were characteristic of the method. It is not the case, however; and it is perfectly possible to produce oil prints which, as far as both delicacy and gradation are concerned, will hold their own with those by any other process. The elements of success seem to lie in correct exposure and in patient, delicate, and continued work in the inking-up, keeping the quantity of pigment on the print at a minimum all the time, and when as much is on as seems to be needed, and it is surprising what a very little is needed, going over and over the print with the brush until the required result is obtained. Every time it is gone over, the distribution of the pigment should be less granular and more in accordance with the light and shade of the original subject.

Bromoil, as already indicated, is a combination of ozobrome and of the oil process. It has the great advantage over "oil," that it does not require a negative of the size of the print; but may have for its basis a bromide enlargement. In referring to bromide enlargements we are anticipating matters, as they are

considered in the next chapters; but this seems to be the natural place for dealing with bromoil. In bromoil, the first proceeding is to make a good bromide print or enlargement, for which purpose one of the ordinary bromide papers may be used, or if preferred a paper made specially for the purpose. Although the fixing of the print can be dispensed with at this stage, it is better to fix it, using a plain rather than an acid hypo bath, and washing thoroughly before drying. The dry bromide print is placed direct into a solution which contains potassium bichromate, bromide, ferricyanide, alum, and citric acid. This may be made up very conveniently by using the "pigmenting solution" prepared for the ozobrome process. Special solutions for the purpose are also obtainable from the dealers. In a suitable solution of this kind the image on the bromide print soon bleaches until nothing but a greyish-brown impression of a very feeble kind remains, and the paper, after a brief washing, is placed in dilute sulphuric acid (5 per cent.) for a few minutes, five or six are usually required. Further washing may be given, then fixing in the hypo solution containing two ounces of hypo and a quarter of an ounce of sodium sulphite to the pint, then more washing for four or five minutes, and the paper is ready to be inked up.

It will be found, if all has been carried out properly, that the paper will take the ink very much as it takes it in the "oil" process just described. Although before inking-up, the image, as far as colour is concerned, will have been bleached right away, the picture can still be seen on the paper, as it stands out in relief to a more marked extent than is the case in oil-printing. There are minor differences in the method of inking-up in order to get the desired effect; but in principle, and to a very great extent in detail also, the pigmenting of a bromoil print is the same as of an oil print.

As photographers became familiar with the oil and bromoil processes attempts were made to ink up different parts of the print with different colours, so as to obtain some approach to the colours of nature. In the future it is possible that much may be done in this direction, although it is getting further and further away from anything that may claim to be photography. Mr. Frank H. Read has been one of the most successful exponents of the process up to the present, and a reproduction

by the three-colour process from one of his oil prints in colours forms the frontispiece of this volume.

One other development of these processes remains to be noticed. As soon as the inking-up is complete, and while the paper is still wet, a sheet of some other suitable paper, such as a hand-made drawing paper, may be laid down upon it, and the two, suitably backed up, passed through the rollers of a press. The ordinary household wringing machine is said to be suitable if it is well screwed down. On stripping off the paper after pressing it in this way, the ink will be found to be transferred from the gelatinized paper on which the picture was inked up to the plain paper. One worker has demonstrated the fact that the transfer can be effected by rubbing the paper with the fingers without any rolling at all. The pictures that can be obtained in this way are very attractive, as it gets rid entirely of the glazed or coated appearance which is inseparable from the gelatinized paper that must form the original basis of an oil or bromoil print.

CHAPTER XVII

BROMIDE PAPERS

Machine-printed bromides—Qualities of paper—Exposing—Gauging exposures—Development—Lighting the dark room—Developer formulæ—Washing—Gaslight papers—Toning—Hypo-alum—The Blake-Smith process—Intensifying bromide prints—Ferguson's copper toning—Uranium toning—Blue tones—Ozobrome.

THE printing methods that have been considered so far have all been such that daylight was necessary, or at least was almost a necessity for printing. There remains one and only one which may be carried out by means of ordinary forms of artificial light, and this is merely a modification of the process used in negative making.

It is to Swan that we owe the idea of applying the dry-plate emulsion to paper on which a positive print could be developed; and in his bromide paper patent, he not only contemplated this, but also the use of machinery by which a band of such paper could be impressed with a series of prints from the same negative, developed, washed, and dried. At the time of his patent, long since expired, this was little more than a possibility, as the developers then known, although they could be used to give very fine prints, did not lend themselves to use in a machine, because of the necessity of an acid bath which they entailed. Nowadays, with modern developers many such machines are in successful operation, and editions of thousands of bromide prints have been made in them for book illustrations, while the little photographs which are inserted in packets of cheap cigarettes are printed in this way, not in thousands, but in millions. In these machines the paper is led in a long band under the negative, where it is held for an instant while exposure is made to an electric light, and then passes along through a succession of tanks holding developer, a fixing bath, and water, finally emerging in a state requiring

nothing beyond drying and cutting up. Such machines are in use by Messrs. Wellington and Ward, the Rotary Photographic Company, and others, and have considerable commercial importance; and a simple device on similar lines for making a number of prints quickly has been brought out by Messrs. Marion and Co. But all of these are more for the manufacturer and professional than for the amateur, whose printing apparatus need not exceed the plain printing-frame and the usual dishes and solutions.

There are two distinct classes of such paper, which for convenience are usually known as "Bromide" and "Gaslight" paper respectively; but it must not be supposed that either term is necessarily descriptive and accurate. It is commonly believed that gaslight papers contain not only silver bromide, but silver iodide and chloride also. This is by no means a hard-and-fast rule; but whatever their composition, the terms are convenient and are generally understood. Bromide paper can be made as sensitive as the fastest plate, but nothing would be gained by such rapidity, and much comfort in working would be lost; so that the fastest bromide paper on the market to-day is certainly not more rapid than a very slow plate indeed, while the slowest gaslight paper is a long way behind even that standard of sensitiveness. Gaslight papers, as their name implies, are sufficiently insensitive to be worked in gaslight. It should never be forgotten, though, that their insensitiveness is not absolute, but only a question of degree, and that if they can be developed by gaslight, they can also be printed by it, and therefore fogged by it. A simple plan to prevent any risk of this sort, is to erect a screen—a drawing-board will do—between the light and the dishes in which the print is developed, filling the frames and developing and fixing the prints in the shadow of the board.

In printing on bromide paper by contact, and still more when printing in the same way on an ordinary dry plate, the photographer is surprised at the extreme shortness of the exposure. He is accustomed to exposures in the camera of a second or so to daylight, and knows that with artificial light these have to be enormously prolonged; he may lose sight for the moment of the difference between letting the light enter his camera by a small hole at the lens, and be spread over an area many times the size of that hole, and the same light

striking straight through a negative to the plate. Over-exposure is, therefore, the tendency at first. If an average negative is put in a printing frame, a rapid plate put behind it, and the frame held up to a gas-burner at a distance of say 2 feet, it will not be possible to turn that burner up and down quick enough to avoid over-exposure, and the frame would have to be moved a good deal further away. Bromide paper is nothing like so fast as the plate, but at 3 feet from an ordinary gas-burner the exposure is only a matter of a few seconds. Gaslight paper at the same place might want anything up to an hour or more, and is therefore printed at a much shorter distance.

As on bromide paper there is no image visible until it is developed, there is no need for the printing frame to have a hinged back, while as the exposure is so short, one frame is all that is necessary. With gaslight papers exposures run to minutes, and it may be possible and indeed convenient to have a number of frames exposing at once. While we cannot see the progress of printing, we are able to gauge it with great accuracy, because, doing it by a constant artificial light, we need only take care that the frame is the same distance from the light every time, and is exposed for the same number of seconds. The gas-flame is the usual light, and if always turned up just short of the point at which it "roars" it is reasonably constant, although occasionally it may vary enough to upset one's calculations. No attempt should ever be made to vary exposure by varying the height to which the gas or lamp is turned up, as it is quite impossible to regulate this properly, and to repeat any given exposure obtained in this way. The light should be burning at its best always, and exposure determined by the distance of the frame.

Those who do much bromide printing by gaslight will find it worth while fixing what is termed a Methven screen on the gas-flame. This is a piece of metal—thin sheet-iron will do—3 or 4 inches each way, in whose centre is cut a square hole, with a side, in this case, half an inch long. This is fixed half an inch in front of the flame, so that, viewing the light from any part of the printing frame, nothing but an even yellow flame can be seen through the hole. In this way we cut off much of the irregularity in the power of the gaslight due to uneven pressure, and exposures are much more uniform.

With such a screen it is even comparatively unimportant whether the gas is turned fully on or not, provided the jet is always big enough for the aperture in the screen to be opposite a plain bright flame all over. Gas pressure is most likely to be a source of error in foggy weather and on Sunday evenings, when, as a rule, it is much lower than at ordinary times. The screen may be used with equal advantage on a "paraffin" lamp.

Incandescent gas is much more powerful than is needed for bromide work, but is an excellent light for gaslight printing; but then, as all available light is required, it is not advisable to reduce its power by the use of the screen. This paper is also printed very conveniently by the use of magnesium ribbon, the exposure being regulated by measuring the length of ribbon to be burnt. A small spirit-lamp is useful for lighting the ribbon, which should be held in pliers to prevent burning the fingers.

The distance from the light at which the printing frame should be placed is very important. The exposure increases with the square of the distance, so that at 2 feet we have to give four times as long as at one foot, at 3 feet nine times, at 4 feet sixteen times, and so on. The most convenient distance for bromide paper is generally 2 or 3 feet, and an appliance may be made to carry the printing frame at that fixed distance from the light. The writer uses a hook on the edge of a shelf, the frame having an eye screwed to it so that it can be hung on the hook, which is 22 inches from the gas-jet. If no special arrangement is provided to carry the frame, this latter may have a wooden arm of suitable length screwed to it and projecting in front. The end of the arm is then placed against a prearranged portion of the lamp or gas bracket, and the distance of the frame is then always the same. Or a piece of string may have one end tied to the bracket, the other end being held in the hand which holds the frame. Gaslight papers are generally printed much nearer to the light, to reduce the time of exposure. For quarter-plates or thereabouts, 6 inches is a convenient distance; but the larger the negative the greater the distance to which it must be removed, if uneven exposure is to be prevented. As a guide, we may point out that little irregularity from this cause will be noticed if the frame is always separated from the light by a distance at least as great as the diagonal of the plate.

The thinner the negative the feebler should be the light in

ST. MARTIN'S SUMMER

BY MRS. DUMAS

which it is printed, which is best accomplished by moving the frame further away. Green glass placed over the printing frame has much the same effect in increasing contrasts as it has in printing-out processes. If the glass of the negative is imperfect or marked in any way, it may be that printing at some distance from a comparatively small source of light these blemishes will appear on the print. A sheet of ground glass or tissue paper prevents this by diffusing the light, but upsets calculations about exposure. It is better, then, to hold the negative, moving it about and turning it round, but always at the same distance from the light.

The character of negative required by bromide and gaslight papers varies. Speaking generally, a stronger negative is wanted by bromide than by gaslight paper, which latter seems to work best with a negative that is too thin for any other printing process whatever. But different makes differ in their characteristics in this respect, and some of the papers are specially made for printing from hard or from soft negatives respectively.

The faster the bromide paper the harder may be the negative used successfully with it; but this, too, is only a vague generalization, and must not be pushed too far. There is no such vast difference between the speed of the different so-called "bromide" papers as there is between plates. The Kodak Company make two speeds—one about four times as fast as the other, and most well-known makes are approximately the speed of one or other of these two brands. The fast papers include the Wellington and the Ilford "Rapid," while the best-known slower ones are Marion's, the "Barnet," Ilford "Slow," and the Paget paper. The "gaslight" papers are, of course, far below the slowest of these in speed.

There is a little appliance made by Marion and Co. which is very convenient for bromide printing, and is shown in the illustration (Fig. 22). Its purpose can be seen at a glance. A negative being inserted in it, with a piece of bromide paper behind, the back — it is like a printing frame exactly — is fastened in. The wooden shutters being withdrawn, the frame is exposed at the proper distance from the light, and the shutters pushed in in succession. If a plate is to be tested for negative work, the exposures need never differ by less than double or one-half that of the next each way. That is to say,

if four seconds' exposure is correct, neither three nor six can be noticeably incorrect; and, in fact, it is hardly possible to detect the difference in exposure represented by three and four seconds, or by four and six seconds, and the difference between three and six will only just be noticeable. Photographers who have never given much thought to this subject almost invariably vastly overrate the effect of such differences, and we have even heard two skilful workers discussing whether a certain subject should have eight or ten seconds; whereas if they had given two similar plates those two exposures and developed them together, it is certain that they could not pick out which had the longer exposure from the prints, and very doubtful if they could do so from the negatives. If they did, it would be by taking into consideration appearances that were quite without any printing value. Accordingly, in negative work, we double or halve exposures at the least. If two seconds is insufficient, we know that four cannot possibly be too much; and if thirty seconds is more than is needed, we may be equally confident that fifteen is not too little. In printing on bromide paper this is not the case, and exposure must be more accurately timed, as slight deposit, which on a negative would be quite invisible viewed by transmitted light, is enough on a print to degrade the whites and make it look—as, indeed, it would be—overprinted. In using Marion's "speed-testing frame," therefore, with bromide paper, we use shorter intervals than half or double. As it is not simple to determine the exact geometrical mean between the exposures, it is best to let every other exposure be double, and to close the shutter for the intervening ones halfway between the two. Thus, if we suspected that sixteen seconds was the correct exposure, we might shut the six shutters thus—

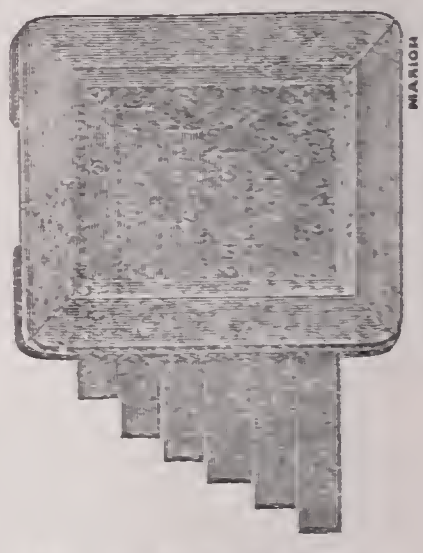


Fig. 22.—Marion's Print-testing Frame.

No. 1	6 seconds.
No. 2	8 "
No. 3	12 "
No. 4	16 "
No. 5	24 "
No. 6	32 "

On development of the print so exposed, we might find that an examination of it was sufficient to show that twelve seconds was a little too short and sixteen a little too long, and give fourteen accordingly.

There is no need to use the "speed-testing frame" for every negative by any means ; but it is useful in taking up a new make of bromide paper, or in dealing with a negative that is much out of the common in point of density, or when bromide printing has been put on one side for some time, and is unfamiliar. It is, of course, equally useful with "gaslight" papers, and, in fact, is a little appliance which will save its cost in no time. It is impossible to urge too strongly, if there is any doubt at all about exposure, the economy of deliberately using a piece of paper for such a series of trials. The wastefulness of making a print which, if wrong, only gives a very vague clue as to the correct exposure, and may have to be repeated five or six times before getting it right, is only apparent when this has actually been done.

Bromide paper can be developed in a bright yellow light; but as there is yellow and yellow, and as some of the yellow glass on the market lets pass a great deal of light to which rapid bromide paper is sensitive, a trial should be made before placing implicit reliance upon the dark-room window. It is sufficient if a piece of bromide paper is placed in a dish where development is usually carried out, and half of it shaded by a card, which ought not to be quite in contact with it, as the card itself may affect the paper if it is not quite pure. After leaving the paper exposed like this to the yellow light for two minutes, it should be developed, keeping the dish covered all the time, and should show no difference between the exposed and unexposed portions. A light that is safe for plates is *a fortiori* absolutely safe for bromide papers, and may be used by those who do not mind its obscurity. But the comfort of working in a profusion of safe yellow light has only to be experienced to be adopted.

The development of these papers calls for little comment. It is usual to soak the bromide paper in water first, as this makes it possible to develop with a smaller quantity of solution, and as the developers used for bromide paper generally act very quickly, it reduces the chances of uneven development; but it is not otherwise a necessity. Gaslight papers give the

best print when the development is very rapid, and it is therefore customary to place them in the developer while still dry. The developer employed for these papers is, for the same reason, much stronger than that which can be used successfully with bromide papers. With both papers the development must be complete and definite if the print is to be a good one; any attempt to curtail development to keep the print light, or to push it on to remedy under-printing, or to restrain it with bromide to counteract excessive exposure, results in loss of quality.

The developed image in a print has not only to be of the right depth or vigour, as it has to be in a negative, but another condition is imposed which does not obtain in negative-making—the image must be of a pure black colour. This is not the case if the developer has been unduly diluted, while the presence of more than a trace of bromide causes the picture to be a most unpleasant greenish tint. For this reason the same developer must not be used over and over again too often, since the result of its action on the paper is to produce bromide in the solution. At the same time, as it is convenient to use plenty of solution in order to be able to cover the paper quickly, and as the coating of emulsion on bromide paper is much thinner than on a plate, the developer is not so quickly exhausted, and may be used until there is any sign of the production of a poor colour.

If the development of a properly exposed print is watched, it will be noticed that after the image has reached the proper degree of vigour the action of the developer seems almost to cease. If the print is then torn in half, and one half fixed, while development of the other half is continued for nearly as long again, and it is then fixed also, we shall see, on comparing the two, that there is very little difference between them. That portion which was developed for the longer time will be very slightly darker, and possibly discoloured a trifle in the high lights, but although developed for twice as long, it will not be twice as vigorous. The action, in short, has proceeded to a certain point and then virtually ceased, and experience will soon teach the bromide printer, if he will not learn it by precept, that it is only when the paper is correctly exposed and development is carried to that stage, that he can expect to get the best the process will yield. This is particularly the case with prints that are subsequently to be toned. With gaslight papers the stoppage of development is less marked, and the

discoloration of the whites by prolonged action is more noticeable, but it occurs all the same, and complete development is just as necessary if a good rich print is to be obtained Much of the disfavour with which the bromide process was once regarded was due to the production of poor prints from insufficient development.

Formulæ for the development of bromide and gaslight papers are legion. Every packet sold contains particulars of the solution which the maker finds best suited to his own papers. In the early days of bromide printing ferrous oxalate used to be employed for the purpose, but it was necessary to wash the prints in dilute acid immediately after development, to get rid of the iron salts, and then to wash out the acid before they could be fixed ; so the ferrous oxalate developer was soon supplanted by others which did not entail so much trouble, although, as far as the quality of the print is concerned, it has never had a superior. Amidol is that which is now the most popular.

Both bromide and gaslight papers should be rinsed after developing and before fixing. Some makers advise the contrary, in order to safeguard their papers from suspicion owing to the washing being carried on too long ; but it is well neither to omit it altogether and so to carry developer into the fixing-bath, nor to take very long about it, especially in the case of gaslight papers, and so involve a risk of discoloration of the whites. A mere rinse of three or four seconds' duration will remove a good deal of developer.

The hypo bath may be a plain one of two ounces to the pint, but an acid fixing bath is very much to be preferred, as it is all-important to keep the prints a good colour, and the acid bath helps to ensure this. Methods of preparing it have already been described (page 134); the simplest and most satisfactory is to add two drams of potassium metabisulphite to each pound of hypo. The prints are plunged beneath the surface of the fixing solution, and should be left there for a quarter of an hour. Almost immediately they are immersed, a kind of clearing or brightening of the picture will take place, but this is no indication that it is fixed, and there is nothing to tell when fixing is complete. The only plan is to take care that the fixing bath is a new one, is of the proper strength, and is allowed to act for a sufficient time. It is very important that the prints should be kept well below the surface of the bath while fixing, and also well under water until most of the

hypo has been washed out. If this point is neglected, the action of air and of the hypo together will lead to an irregular reduction of the image and to stains, which are quite without a remedy and spoil the print entirely. As the prints have a tendency to float up, some means should be taken to prevent this. A very simple plan is to immerse them face downwards both in the hypo and in the washing water, and to place a xylonite dish on the top of them, in which water is poured until it floats so deeply as to keep them well below the surface.

The washing of prints on bromide or gaslight papers is carried out in the same way as that of negatives or of prints on P.O.P. It is important to get rid of the hypo, if the print is to be permanent; but if this is done there is every probability that the result will be much more lasting than in the case of a print on P.O.P. The image in a bromide print consists of metallic silver enclosed in gelatine, while in a P.O.P. print the image is formed of a mixture of compounds of which little definite is known, except that they are very readily attacked by sulphur, which may get to them from traces of hypo, from an impure atmosphere, or from attachment of the print to an impure mount. The author has a bromide print which was made in 1887, and has been hanging up, framed, without any special care ever since, and is to all intents absolutely unaltered.

An ingenious modification of the bromide process was that introduced by the Rotary Photographic Company, and known as "Carbograph." The emulsion contained pigment as well as silver bromide, in fact it was a kind of cross between carbon tissue and bromide paper. Enlargements could be made direct upon this, with artificial light, just as on ordinary bromide papers. After development, which had to be carried out by time, as on the dark surface of the Carbograph little of the image was visible, the print was placed in a solution which contained potassium bichromate and alum. It was then squeegeed on to transfer paper and developed like a carbon print, the silver image which was first developed being left in or taken out with a suitable reducer at the discretion of the photographer. As a means of making carbon enlargements direct, there seemed to be great possibilities before this process, but it obtained no popularity, probably from the greater simplicity by which similar results could be obtained with ozobrome.

Gaslight papers possess the peculiarity that by giving them prolonged exposures and then developing in suitably restrained solutions, the colour of the prints may be modified from black through a series of sepias and browns right up to bright red, and when they were first introduced much stress was laid upon this feature. It is difficult to say precisely why so little is heard of it now, but the fact remains that it has almost entirely gone out of use. Probably the uncertainty of the tone and the necessity for considerable skill in determining when to stop development, and in making a number of prints of the same colour has had much to do with it.

If development to obtain warm colours has to a great extent gone out of fashion, there has been an enormous increase in the popularity of certain toning methods; to such an extent, indeed, that at some exhibitions toned bromide prints or enlargements have formed 80 per cent. of the total number. While there are many ways of changing the colour of a print, in many cases it is only a change for the worse, but the brown tone obtained by the conversion of the silver image into one of silver sulphide is often a great improvement, and it is this toning method which enjoys the greatest favour. Moreover, if the conversion is a complete one, as it may be under proper conditions, there is no reason to suppose that the toned print is any less permanent than a black one, which is certainly not the case when other toning processes (notably those in which uranium is employed) are adopted. The change of the silver into silver sulphide may either be direct or indirect. Both methods are in everyday use; the former is generally known as the hypo-alum process, the latter as the Blake-Smith, from the name of the gentleman who first studied it and introduced several new methods of carrying it out.

A most ingenious process by Mr. T. Manly, the inventor of Ozotype, combines the advantages of bromide and carbon printing, and is known as "Ozobrome." A bromide print or enlargement is soaked for a few minutes in clean cold water, and a sheet of carbon tissue is meanwhile soaked in a patented solution called the pigmenting solution, and supplied by the Autotype Company. The solution contains, in addition to certain hardening agents, potassium bichromate, potassium bromide, and potassium ferricyanide. The tissue, having absorbed what it will of this solution, is squeegeed down upon the bromide print

and left in contact with it for half an hour, more or less. Under these circumstances a curious change takes place. The potassium bromide and ferricyanide attack the image of the bromide print and cause it almost to disappear, just as a mixture of those salts in solution does when applied to the bromide print in the process of sulphur toning. The bye-product of this reaction acts in turn on the bichromate, this in turn rendering the tissue insoluble just where it is in contact with most silver on the bromide print. So that in its effect on the carbon tissue, contact with a bromide print, under these conditions, is equivalent to printing under a negative.

The print on carbon tissue so obtained is developed with warm water in the usual way. It may be left on the bromide print and the two placed together in the warm water, the paper backing of the tissue pulled off and the picture developed on the bromide print itself. A better plan is to separate tissue and bromide print under the surface of cold water, to squeegee the tissue on to a piece of transfer paper and then to develop it, and to wash the bromide print thoroughly in water. It may then have its image brought back to full strength by the application of any ordinary developer for bromide work, and is ready for a repetition of the operation. The only limit to the number of carbon prints that can in this way be obtained from a single bromide—or gaslight print, for that does equally well—is the capacity of the paper to stand the repeated wetting and pulling about. If the Ozobrome is developed on the bromide print, the image beneath may be left as it is, or redeveloped to enforce the print above it, or turned into silver sulphide, as in the Blake-Smith process. Or all traces of it may be removed by means of hypo, or, if need be, the ferricyanide and hypo reducer.

Ozobrome when first announced seemed to present great advantages to the exhibiting photographer; but for some reason or another it has never enjoyed anything more than a very restricted popularity.

WINDLESS

BY W. THOMAS

CHAPTER XVIII

ENLARGING, REDUCING, SLIDE MAKING

Enlarging—Illumination of the negative—Diffusers and condensers—The optical arrangements—Daylight—Curing distortion—Exposing on bromide paper—On dry plates—Developing—Slide making—By contact—A lantern-slide printing frame—Slide cameras—Development—For warm tones—Intensifying slides—Clouds—Dodging slides—Mounting and spotting—Masking—The lantern screen—Small displays.

THE growth in popularity of the hand-camera has caused a corresponding increase in favour of methods of getting a large print from a small negative. There are two systems by which this can be accomplished, each having its good and bad features, and each its devotees. One is by enlarging direct upon bromide paper—a method which dispenses with all intermediate stages and by bringing the final large print closer in its connection with the original negative, is capable of as great a degree of accuracy in rendering its tones as in any contact printing method. The other is by making an enlarged negative—a process which is inevitably accompanied by loss of truth of tone, but has the great merit of allowing the final print to be made by contact and consequently by platinum, carbon, gum, or any other method affected by the photographer.

All enlarging is re-photographing, and requires a lens and a camera. True we may enlarge with a lantern in a darkened room, but this is not dispensing with a camera, since the room itself becomes the camera in such a case. And we can substitute a pinhole for the lens, if we have a reasonable anticipation of living to the end of the exposure. The essential fact to grasp is, that it is actually a repetition of the original operation. The subject is the small negative, the lens the lens of the enlarging lantern or camera, the bromide paper corresponds to the plate, and the space between the lens and paper is the camera. The

first important proceeding is to arrange for the illumination of the negative.

This can be done either by diffused light, or by means of a condenser, and the distinction between the two should be clearly understood. If we place a negative as at N (Fig. 23), with a lens at L, and paper at P, and illuminate that negative by a light, I, with the idea of obtaining an enlarged image on P, we shall

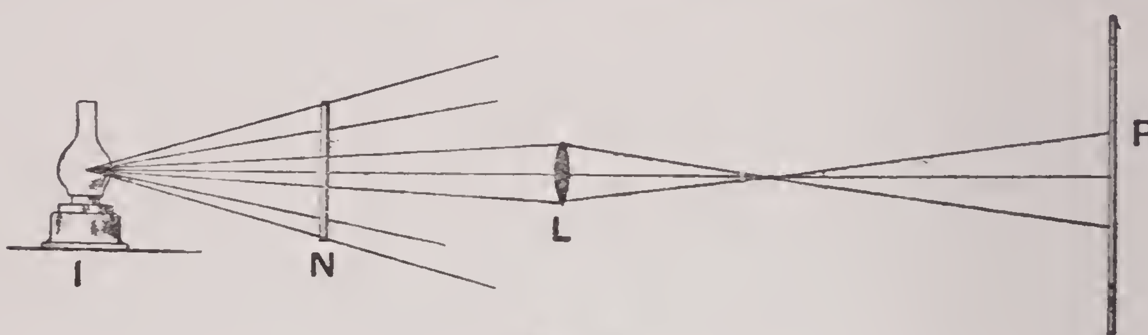


FIG. 23.

find that the only part of the negative which is properly lit is that which lies in a direct line between the lens and the lamp—that is to say, the centre. The rays from the lamp, as shown in Figure 23, proceed in straight lines in all directions, only a few reaching the lens and thence the paper P. But by placing a lens, C, between the negative and the light, as shown in Fig. 24, the rays may so far have their direction altered that they now

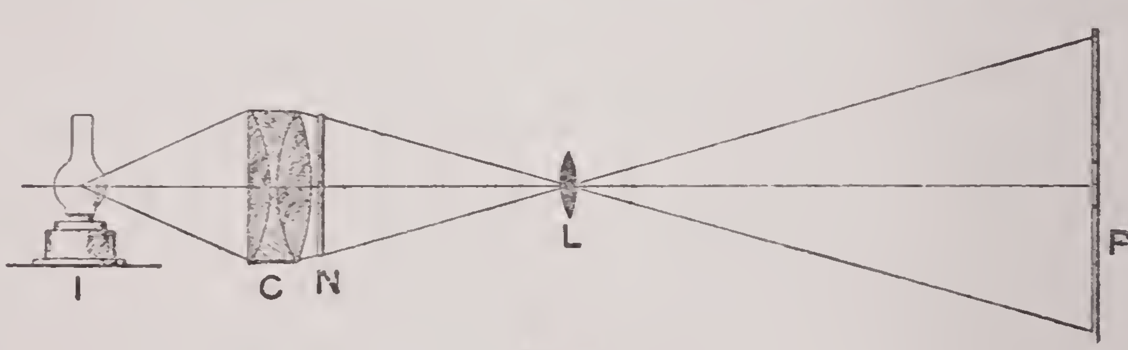


FIG. 24.

all practically meet at L, and the image formed on the paper P shows the whole negative evenly illuminated. Such a lens, C, is called a condenser, and is used in all optical lanterns for projecting slides, the arrangement of which, substituting the slide for the negative N, is precisely that shown in Fig. 24. A condenser is also used in most enlarging lanterns. It must not be supposed that there is any essential optical difference between a condenser and any other lens. The so-called

condensing is precisely the same action as that of any other lens placed in the same position, and is due to the fact that the condenser is forming an image at L of the light at I. To make this clearer, any one with a condenser can hold a sheet of paper at its focus at L, and will see not merely a spot of light, but an actual inverted image of the flame and of the brightly lit parts of the lamp. Consequently, I and L are conjugate foci, and the nearer we push the lamp I to the condenser, the further off will be the point L, at which the rays of light are brought by it to a focus.

Another fact may be gathered from the preceding paragraph. If the concentrated spot of light at L is an image of the light itself at I, the nearer the light is brought to the condenser the larger will be its image at I, just as the nearer the lens of the camera is to an object the larger is the picture on the screen. Also the larger the light itself is the larger will be its image, if the distances I C and C L remain the same. Therefore, if the light is too near the condenser, or if the source of light is too large, it may make a bigger image at L than the lens itself that is placed there, and all the light will not get through the lens. On the other hand, if the source of light is very small, or its distance from C is increased, the image at L may be such a spot of light that it only occupies a small piece in the centre of the lens. It does not often happen that it occupies the whole of the lens at L when we are enlarging with a condenser, and this has an important bearing on the subject of exposure.

A small stop, we know, improves definition, because, to a certain extent, only the centre of the lens is then used to form the image. If the condenser forms at L such a small image of the light that it only occupies the centre of the lens, the margins of the lens are not used, and it is possible to insert a smaller stop in the lens at L without cutting off any of the light that is passed by the lens. Therefore under such circumstances, the insertion of a smaller stop does not necessarily increase the exposure, as it does in ordinary camera work. It may not increase it at all; but if it does, the rule as to the exposure doubling with each stop in succession as we pass from one to the next size smaller, does not hold good. When enlarging with a condenser, therefore, the exposure must be ascertained for the particular stop that is being used, there being no

reliable method of ascertaining the alteration in illumination brought about by a change in the size of the stop.

Further consideration of the diagram (Fig. 24) will explain also how it comes about that the smaller the source of light the finer the definition in the enlargement, until when we come to work with the spot of light of an electric arc lamp we are practically using a small stop in the lens, although actually it may be fully open. The definition, when enlarging with an arc light, is at times so fine as to be troublesome, every speck and blemish in the glass of the negative appearing faithfully and enlarged on the screen.

The adjustment of an enlarging lantern is performed in three stages. First, the lantern is set up with the negative in position and focussed on the screen. The distance of the screen decides the degree of enlargement. When this has been done, the distance of the light from the condenser has to be adjusted, so that the latter brings the image of the light upon the lens L. This cannot be done before, because until we have got the picture the right size and focussed we do not know the final position of L. The negative is therefore taken out of the lantern, and the light adjusted, until a perfectly evenly illuminated disc is seen on the screen at P. This is an indication that the light is in the right position, and the negative may be put back. It is best, then, to focus it again, as it was difficult to do so before the light was right, and the slight further focussing is not likely to disturb the illumination. We are then in a position to expose.

So much for enlarging with a condenser. If we return now to Fig. 23, it will be obvious that if the negative were no larger than that small portion of it which lay in the direct line between the lens L and lamp I, it would be illuminated evenly without a condenser; or, what comes to the same thing, the whole negative N would be evenly illuminated if the source of light were sufficiently large. It is not practicable to get a direct source of light of such a size, but it is easy to get it indirectly. Instead of the condenser C, we may substitute a screen of ground glass, G (Fig. 25). This scatters or diffuses the light passing through it, so that some light from every part of its surface will reach the lens L, although, as it scatters the light indifferently in all directions, only a comparatively small proportion

of that which falls on the ground glass will reach the lens, and not all, as was the case with the condenser. Hence the exposure with such a diffuser will be much longer than with a condenser; still, every part of the negative will be lit, and not merely that which lies in the line between the lens and the light. Instead of the ground glass, a smooth reflector of white

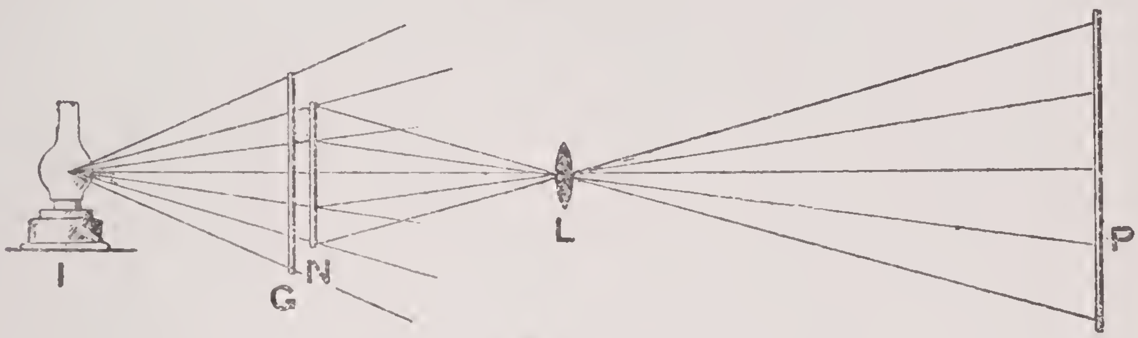


FIG. 25.

paper or card may be used, as shown in plan at R (Fig. 26), the result being much the same, except that the reflector is even less efficient, as far as the strength of the light is concerned, than is the diffuser. With these diffusers, as it is no longer a case of a condenser forming a brightly lit spot in the centre of the lens, the negative behaves exactly as if it were a landscape

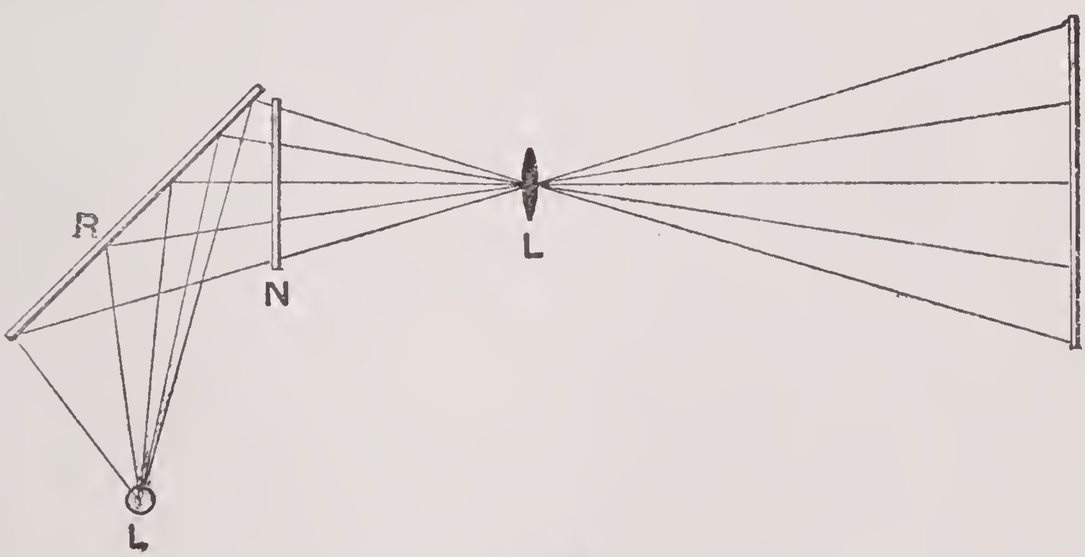


FIG. 26.

or portrait that was being photographed, and as the lens L is stopped down, the exposures are increased in the same way as in ordinary photography. With diffusers, therefore, there is no need to ascertain the exposure by trial with the stop actually used for making the enlargement; we may, if we will, use any other stop for the trial, and calculate from it to the exposure

with the stop finally selected. This detailed consideration of the conditions which prevail when enlarging has to be done is necessitated by the fact that the subject receives very little attention as a rule, and even in the treatises put forward professing to deal with enlarging, there have been statements which were altogether inaccurate in these matters.

A condenser is only used when enlarging by means of artificial light. The apparatus generally employed for such a purpose is a lantern, which only differs from the ordinary lantern for showing slides, in the arrangements for holding the negative, and in the greater care that is given to prevent stray light from getting out of the lantern. This ought not to be a difference, as it is quite as important to keep the room dark when showing slides as it is when enlarging. But when enlarging is in hand, the paper is fogged if there is too much stray light, and the photographer knows that all is not as it should be; whereas in showing slides he does not, as a rule, appreciate the value of comparative darkness. Few lantern exhibitions are as they should be in this respect. The general arrangement of an enlarging lantern is shown in Fig. 27, which is one made by Hume of Edinburgh, and can be used with any illuminant that may be selected. In the form illustrated, it is employed with incandescent gas and a Welsbach mantle. Those who have not got a supply of gas can employ a similar light in which the mantle is made incandescent by means of a spirit flame, as in the "Sol" and "Meta" lamps. Acetylene may be employed, or an oil lamp, or an oxyhydrogen jet, while those who have a supply of current may use the Nernst electric lamp or the arc light. The author prefers a mantle made incandescent with gas or spirit, as it is easy to put up and use, the light does not alter when the lamp is run for some time, and the exposures are neither unmanageably short nor inconveniently long. By placing the enlarging lantern on a table and putting an easel for the bromide paper on the same table,

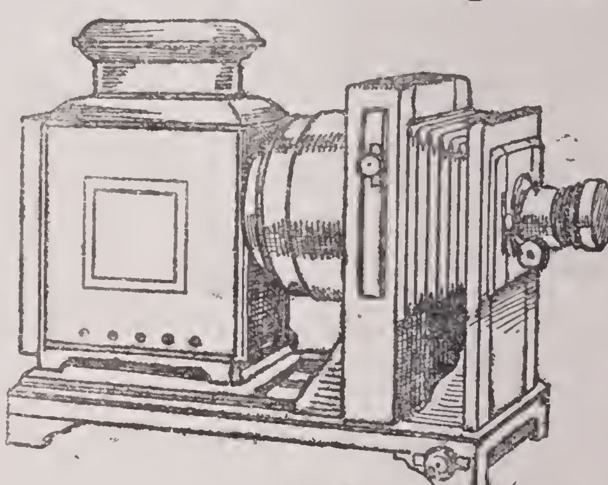


Fig. 27.

there is not so much risk of movement as when the two stand on separate supports.

The cost of a condenser for larger plates than 5 by 4 is out of proportion to the advantages conferred by its use, while its weight makes it unwieldy, and its thickness very liable to breakage. For larger sizes, therefore, it is usual to employ a diffuser. When the light is artificial, one thickness of ground glass is not sufficient, while a white reflecting surface, although giving a beautifully even illumination, entails so great a loss of light that it is not practicable, except with daylight. There is an exception to this—the form shown in plan in Fig. 28. Two incandescent gas burners are placed at A A, and the curved metal reflector, which is whitened inside, illumines the negative evenly and well. This arrangement is commercially obtainable, enclosed in a light-tight lantern, for use in a darkened room. With ground glass, it is usual to employ two pieces, and, in order to allow them to diffuse the light properly, to separate them from each other and from the negative by a space of at least an inch. It is important also that they shall be larger than the negative they are to illuminate, or its edges will not be properly lit. Fig. 29 shows in plan a simple method of

Fig. 28.

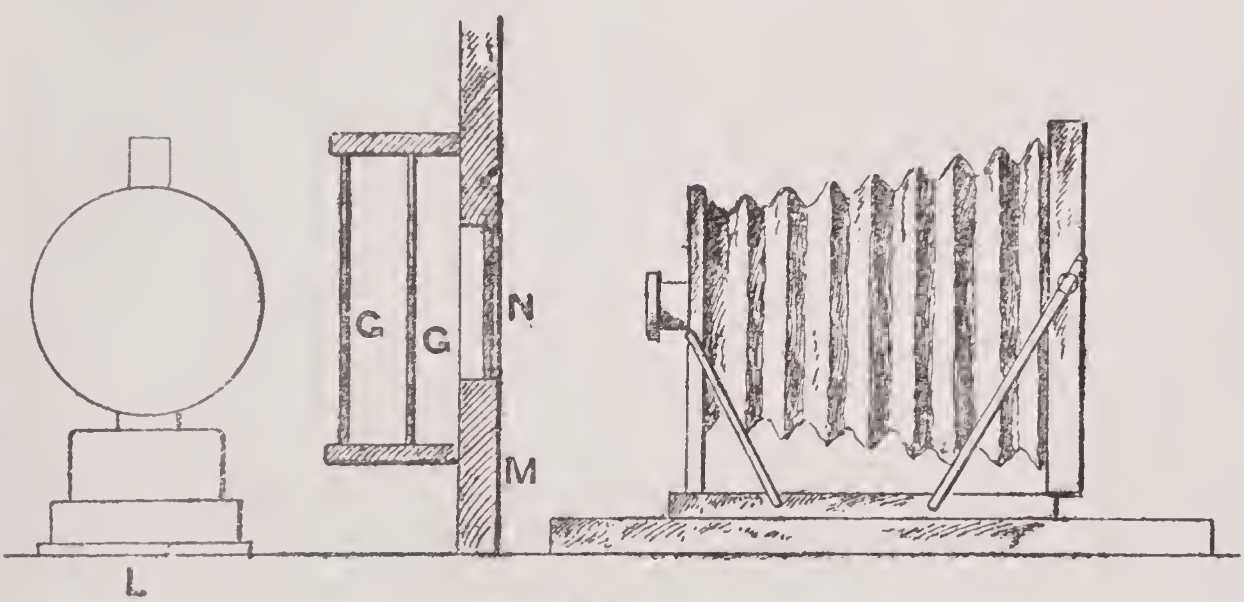


Fig. 29.

enlarging with a camera the size of the enlargement, which dispenses with the need for a dark room. It is not so often used for enlarging, but it is a very common arrangement for reducing and making lantern slides, an operation which differs in no way from enlarging, except in the relative sizes of original and copy. L is an ordinary oil lamp or incandescent gas burner ; G G are pieces of ground glass ; N the negative, placed over an aperture in a piece of card or wood, M, in order to prevent light getting round its edges. There is no need, with such an arrangement, to cover in the space between the negative and the camera. If the arrangement is tipped up, so that there is uninterrupted sky behind the negative as seen from the lens, there is no need for the ground glass, and daylight can be used. As in such a case a small stop is often employed in the lens, it is important to make quite sure that the view of the sky is uninterrupted, as buildings, chimneys, and even a strongly marked cloud form, may show in the result. But clouds are not likely to be troublesome.

Many photographers like to use daylight for their enlarging. The simplest method is by means of a fixed focus enlarging camera, which is merely a box or bellows, at one end of which the negative is placed, and at the other end a holder for the bromide paper. Between the two, in such a position that it forms a sharp image on the paper, is fixed a single lens. In the simpler forms, the whole arrangement is carried into the dark room to insert the bromide paper, and then carried out and placed on end so that the negative is exposed to the uninterrupted light of the sky. More elaborate patterns have a dark slide in which the paper can be carried. The best method, however, is to have an opening into the dark room (Fig. 30), which can be closed with the negative itself, or with a frame holding it, and provided outside with a white reflector. The ordinary camera with which the negative was taken may be placed, with its focussing screen removed, on a bench against the negative, and the focussing cloth used to block out any light between the junction of the camera back and negative holder. The enlarged picture is then focussed on the easel. There is no need to get a special lens for enlarging. Any lens that sufficed to take the original negative may be used to enlarge from it up to any size that may be required.

GRANNIE'S STOCKING
BY ARCHIBALD COCHRANE

It will be seen that the choice of arrangements is a large one, and must be decided by the conditions and by the character of the work to be done. Fixed focus enlargers and apparatus of the camera type suffer from one limitation, which for some work quite puts them out of court—there is no opportunity of modifying the resulting enlargement by shading or dodging during exposure. With an enlarging lantern, or with such a system as that represented in Fig. 30, this is easily done, the photographer standing beside the enlarged image on the easel, and shading it with as much ease as if he were contact

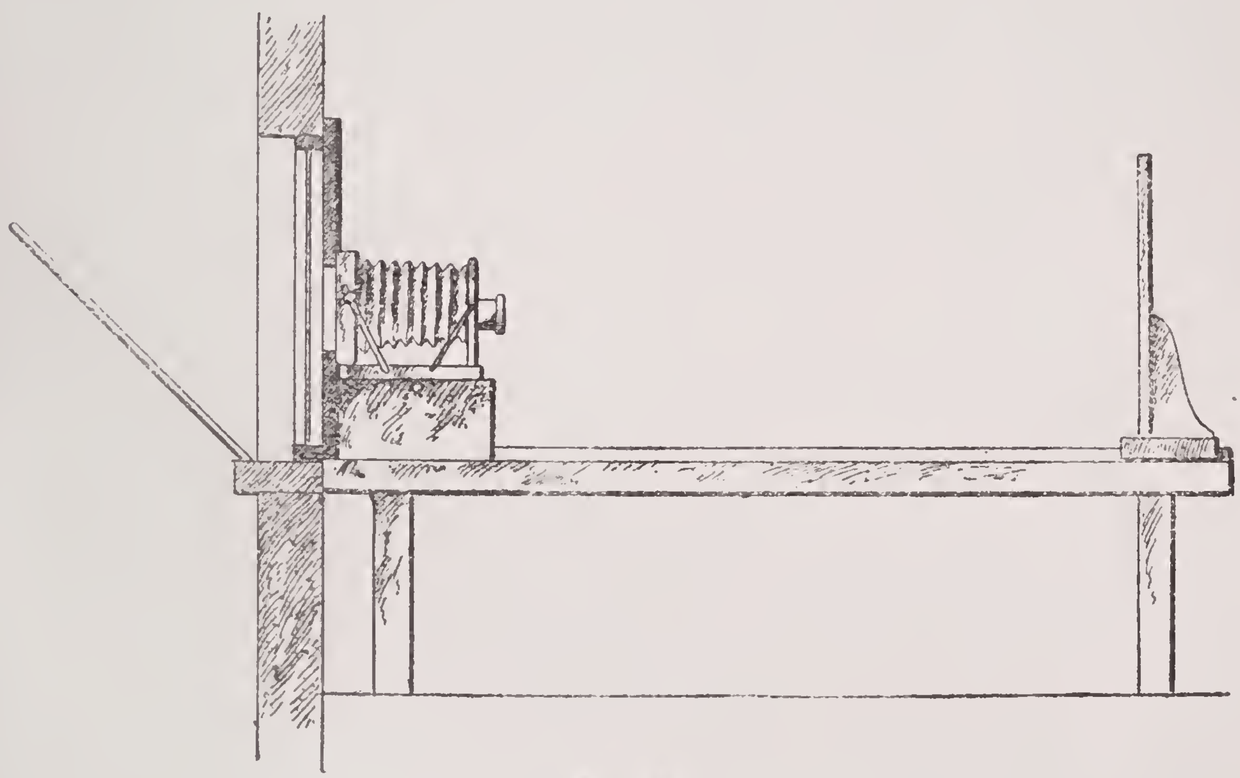


FIG. 30.

printing, or even more. The different means of effecting such alterations are dealt with in Chapter XX. There is one alteration which may be mentioned more appropriately here: it is the curing of distortion due to the camera used in the first case not having been level. The result is that perpendicular lines in the original, in the photograph converge towards the top. If such a negative be placed in the enlarging lantern, and the easel on which the image is focussed is swung so that it is no longer vertical, but that part of it which is receiving the part of the image where the vertical lines are closer together is tilted away from the lens, that part of the picture will be rendered on a bigger scale, and if it is done sufficiently, the lines will be made parallel again, and on a superficial examination there will

be no distortion noticeable. The method has two inconveniences: a very small stop must be used in enlarging, to bring all parts of the image to a sharp focus on such a surface, and it also introduces foreshortening, or perhaps, to avoid accusations of inaccuracy, it would be best to call it "forelengthening." These are both surmounted by inclining both negative and screen, as shown in Fig. 31. The exact inclination of each can be calculated, but for all ordinary purposes it will be found that a result which is practically free from distortion can be obtained by tilting both till the convergence disappears, while the degree of tilt given to the easel is a little larger than that given to the negative. Some enlarging lanterns allow the negative to be swung in this way, and it is easy to swing it when the

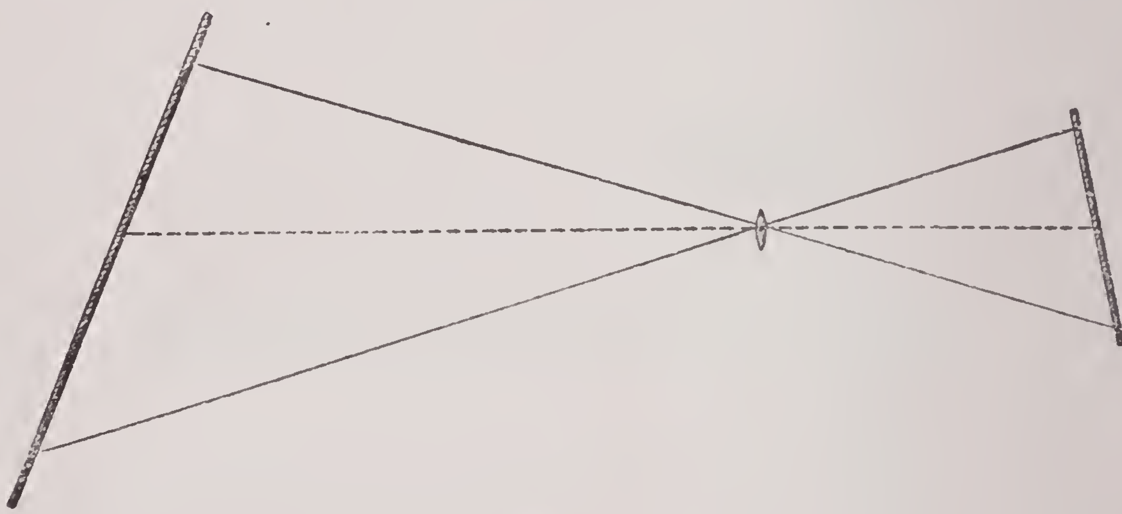


Fig. 31.

arrangement shown in Fig. 30 is being used. There is then no need to tilt either negative or easel, as, by placing the negative on its side, the camera may be twisted slightly round on the table, the easel being moved and twisted also, until the vertical lines in the subject are all strictly horizontal in the enlargement. A similar method has been used, or suggested, for curing the distortion, cushion or barrel shaped, due to the use of a single lens, by making an enlargement—which, to use an Irishism, may be the same size, or even smaller—with the same lens with the stop in the same position, as regards the original negative, as it was when that was taken. The second bending of the lines is in the reverse direction, and therefore tends to correct the first.

The bromide paper usually employed for enlargements is fastened on the easel with pins, or may be held under a sheet

of glass. A piece of white paper is fastened on the easel for focussing purposes, or in some enlarging arrangements the easel carries a ground glass focussing screen, focussing then being done from the back as in an ordinary camera. A third method combines the two, a hole an inch or two in diameter being cut in the easel, and glazed with a piece of ground glass, on which fine focussing may be done with a magnifier. This is a refinement which is not required unless the illumination is very poor indeed. All the needful arrangements can be made very easily on the white paper. When this has been done, the lens is covered, not with an ordinary opaque cap, but with one glazed with yellow glass, so that the adjustment of the bromide paper in the exact position required is facilitated.

By substituting a plate for the bromide paper, and a positive transparency for the negative, an enlarged negative can be made. The plate should be a slow one and backed. The positive must not be one of the same character as a good lantern slide. In lantern slides, the highest lights should be almost transparent, or the slide will not look bright and effective on the screen. Such a positive makes a very poor enlarged negative, as it is not possible to keep the detail in the shadows ; in fact, theory confirms what practice has long shown to be the case, that while it is possible from a good print to obtain a fair quality negative, it is not possible to make a good negative from a good lantern slide, and the better the slide, the less suitable for the purpose will it be. The positive for enlarged negative making requires a longer exposure than does the same plate when a slide is to be the result, the positive being kept thin and possessing a distinct and printable image in its highest lights. In developing enlarged negatives, those who are only accustomed to deal with small ones are sure to have a tendency to over-develop. The wider separation of the high lights and shadows, due to their size, makes the negative seem much thinner than it actually is. Time development in this is as useful as in other cases. As large plates are expensive, bromide paper has been used successfully for making enlarged negatives, as has also negative paper. A negative on bromide paper must not resemble a good enlargement, but should look like an enlargement that was both over-exposed and over-developed. Some

workers make such an enlargement direct from the negative, and then print an enlarged negative from it, by contact; but the usual practice is to make a small transparency, and to make the enlargement from that. If enlarging is only done occasionally, it will be found economical to use the first plate or the first sheet of paper in making a graduated series of exposure tests. In making an enlarged negative the exposure of each strip should be double that of the preceding one, but in making enlargements on bromide paper there should be at least one intermediate exposure, as was explained in the chapter on bromide printing. In most packets of large size bromide paper a small piece is included for the trial exposure. This is of little use, as it is not often possible to get a really reliable guide to exposure from a piece less than half the size of the entire sheet. The small piece cannot take into consideration any widely separated tones; and if a guide is needed at all, it is needed to give information accurate enough to save wasting a whole sheet of paper. A sheet or half a sheet used deliberately on a test should give precisely the information required, whereas a sheet exposed in the ordinary way, if found to be incorrectly exposed, only gives a rough suggestion of what the correct exposure might be, and it may take three or four more pieces, used in the same way, to get the best result.

II

It has been said that the greatest test of technical excellence in a negative is making a lantern slide from it, and the observation is very true. Prints can be dodged to an unlimited extent, minute pinholes in the negative are lost in a rough surface print, even large holes can be stopped out entirely with a little skill, so as to pass quite unnoticed; but spotting on a lantern slide is almost impossible. The searching magnification it gets on the sheet, the complete absence of anything to correspond to the texture of the surface of a paper print, the difficulty, or rather, the impossibility, of making a complete match in tone and outline between pigment applied with a brush and the delicate shades of the developed image, all combine to demand that the slide to a great extent shall be an "unfaked" copy

of a flawless original negative. But if the test is a severe one, the result, when successful, more than justifies it. The "optical lantern"—for it is "magic" no longer—properly worked, remains the best method of showing the beauties of a photographic picture. Comparatively few pictorial workers adopt it, but this is only to be expected. Comparatively few pictorial workers are sufficiently capable technicians for their work to stand such a test, but that men like Stieglitz and F. H. Evans have been slide makers is sufficient to show that there is nothing inherent in the process which unfits it as a means of pictorial expression. Those whose ideas of a "picture" are limited to something that might pass as the work of an artist in some other medium—a mezzotint or a monochrome painting, for example—condemn the lantern slide as inartistic. The association of the magic lantern with Sunday-school treats and tea-fights makes those who are keenly sensitive to ridicule avoid anything leading to its use; but the time will come, we are assured, when the fact that pictorial photographers wilfully threw aside one of their most powerful mediums of expression, and one that is peculiarly photographic, will excite the surprise and condemnation of their successors. In the meanwhile, those societies which are cultivating slide work should be encouraged, and the amateur photographer, who has passed the novitiate of negative making, should not regard his progress as complete until it has likewise led him into slide making.

Lantern-slide making, in its simplest form, is merely a printing upon glass instead of paper. Lantern plates are coated with an emulsion of bromide paper character, or thereabouts, and being exposed underneath a negative are developed much as a negative is developed, and yield a black image. A slower form of lantern plate is capable of being exposed for many times the normal exposure for black tones, and then so developed as to give warm colours. This process is akin to that which has been suggested for "gaslight" paper; but most of the lantern plates to which it is applicable, while slower than black-tone plates, are still too fast to be worked in gaslight, and a yellow light must be used for them. Gaslight lantern plates are also made.

Slide making by contact is a very easy operation. In the yellow light the lantern plate is placed behind the negative in

a printing frame, and it is exposed, developed, and fixed. A special form of frame is made for the purpose, and is convenient, but is not a necessity. There is a standard size for lantern plates, so that they may fit the lantern carrier. This in the United Kingdom is $3\frac{1}{4}$ inches square. In the United States the size is $3\frac{1}{4}$ inches in height, and 4 inches in width; so that American slides will fit British carriers of the "push-through" type where width is immaterial, but not other patterns. In consequence of the limitation of size, the largest possible picture on a lantern plate, with due allowance for margin, is 3 inches each way, or a trifle less, and a square shape is very seldom satisfactory We therefore have to confront the difficulty in making slides by contact, that either the negative must be specially taken, occupying a small portion of a quarter-plate—not much more than half—or we can only get a part of the complete subject on the slide. Alas! that it should be so; but in the great majority of slides it is only too apparent that the latter course has been adopted, and the vital parts of the picture are either partly off the slide, or what is even worse, are just squeezed on; so that the one thought in the spectator's brain is the close shave they had to get on at all. The slide printing frame is an appliance to help in the selection of the particular part of the negative that is to be got on the slide. It is a frame provided with a flat surface, which may be of wood or of glass with a mask of the required size. If of wood, it has a square opening in its centre about $3\frac{1}{4}$ inches each way. On this surface the negative is put, film upwards, and is shifted about until the part which is to appear on the slide is seen centrally in the opening, when the back of the frame is fastened on, and holds the negative firmly in position. In the back is an opening a shade larger than a lantern plate, and provided with a door. The lantern plate can then be dropped into this opening so that its film comes against the film of the negative, and the door being closed it is ready for exposure. The greatest advantage of this apparatus is that it removes all risk of sliding the lantern plate on the negative, which would damage one or both if there should be the slightest particle of grit between the two. Otherwise, an ordinary printing-frame, a size larger than the negative, to allow of adjustment, may be used with a piece of clean glass in it, upon which to

place the negative. Some of the finest slides that have ever been made were produced by the collodion emulsion process; but this is now quite obsolete for the purpose, although it is still used in certain photo-mechanical processes. The ordinary gelatine lantern plate at its best, however, will yield results quite equal to collodion emulsion. Unfortunately it is but seldom that one sees the gelatine plate at its best; possibly due to the "fatal facility" with which it can be worked.

The other method of exposure has already been referred to; it is effected by means of the camera, exactly as in enlarging, except that the image is smaller rather than larger than the original. The best slides are necessarily made in this manner, and it enables any part of the negative, or the whole of it, to be reproduced on the lantern plate of the size required to occupy it properly. It is not easy to explain why it should be so, but this method can undoubtedly be made to yield finer definition in the slide than any method of contact printing. All risk of injuring the surface of either negative or plate is avoided, and converging vertical lines can be corrected just as they can in enlarging. The only requisites are means for evenly illuminating the negative, such as have been dealt with in the earlier portion of this chapter, and a carrier to fit into the dark slide to hold a plate $3\frac{1}{4}$ inches square. Fixed focus lantern-slide cameras are made on similar lines to the fixed enlargers. They can be used with daylight in the same way; or by placing a couple of sheets of ground glass, an inch apart, an inch behind the negative, it may then be lit by a lamp, by incandescent gas, or by magnesium ribbon. Exposures are shorter than when enlarging, as the light is not spread over so large an area.

The development of lantern plates, except when black tones are to be obtained, is not so easy as the development of negatives. More light can be employed, but there is much difficulty in determining when to stop development, on account of the colour of the deposit, which is light, and not so very different from that of the unaltered sensitive salt. There is not the extensive range of developers that are applicable for negative making, as some of these give colours which in a lantern slide are not attractive; but there are still very many that can be used, pyro and hydrokinone being the most popular.

To obtain warmer tones, the developer is restrained by adding bromide, and the exposure increased. Most of the text-books put great stress on the control of the colour by increasing the exposure to some definite extent; but this is putting the cart before the horse. The governing factor in the question of colour is the time of development, and this in its turn is influenced by the composition of the developer. To get uniform colour we must therefore employ the same developer each time, and must so regulate the exposure that the development to the proper density is carried out always in the same time. It will be seen that this removes the great difficulty of correct density. The developer is applied for the required time, and the slide is then washed and fixed. If it is too dense, a fresh plate is exposed for a little shorter time; if too thin, the next exposure is longer, the time of development being kept the same.

Lantern plates may be fixed in the ordinary or in the acid-hypo bath, as preferred, and are washed and dried exactly as is done with negatives. Just before placing a finished slide in the rack to dry, it should be held under the tap and rubbed very gently with a tuft of cotton wool. The slightest abrasion of the surface may show when it is on the sheet, so it must be done carefully, and the slide must be dried where there is no fear of dust getting at it, as this when magnified in the lantern is much more apparent than when printed from a negative. Slides on lantern plates may be reduced or intensified in exactly the same manner as negatives. The Wellington intensifier is said not to affect the colour of the slide, but it is doubtful how far this would hold good with very warm tones. All other intensifiers alter the colour, and have a tendency to choke up the shadows; they are best avoided, and if a slide is too thin a fresh one should be made. A slight reduction improves many slides, if it is not allowed to go very far. It just clears up the high lights, and generally makes the slide look cleaner. If carried a shade beyond what is required for such a purpose, the slide is ruined irretrievably, so that it is better not to tamper with a good slide by reducing it in the hope of making it better still. The ferricyanide hypo reducer is the best for the purpose, sufficient of a 10 per cent. solution of ferricyanide being added to some of the fixing bath to give it a pale yellow colour.

GOING TO THE POST

Slides having a warm tone obtained by development may have this modified by applying to the finished slide either a combined toning and fixing bath or a plain sulpho-cyanide and gold bath, such as is used for P.O.P. In this way some very fine purple colours are obtained, and many of the better commercial lantern slides are made by this or by a similar method. As gold toning tends to make a warm colour colder, it is useless to apply such baths to a black-toned slide; but most of the methods already referred to for toning bromide prints are equally applicable to lantern slides, though the colours are not always the same. The sulphur toning mentioned on page 263 gives a very good colour to a black slide, but all toning methods tend to make the slide heavy and opaque, and the colour is never quite as good and transparent as it is in the best slides obtained by development pure and simple.

It is not easy to introduce clouds into a lantern slide, and in most cases the fact of their introduction is apparent and therefore to be condemned. The method usually adopted is to print the clouds on a separate plate, develop it with the first side by side, so as to obtain identical colour, and then to bind up the two together, film to film. Manifestly, this cannot be done when there is a risk of a cloud form showing across some part of the picture on the other glass, and this limits the possibilities. A lantern plate may be fixed up on the enlarging easel, and a small image of the cloud projected on it through the landscape slide—which in this case must be made first—which is placed in contact with it, film to film. The landscape then acts as a mask, and spaces on it where the clouds might print through, and are not wanted, may be blocked up with pigment on the glass side of the landscape. This is a perfect method in theory, but in practice it is hampered by the difficulty of getting clouds and landscape into absolute register and keeping them there. If this is not done, the result can only be described as painful to the producer and ludicrous to the spectators. Still, it is possible, and when done is effective enough.

A supplementary picture on the cover glass has been used as a means of toning down parts, which were too light in the original slide, without affecting the rest. A thin negative image is obtained on a lantern plate by making a contact print with the slide itself as the negative. This is developed, and

the parts which are not wanted are reduced away entirely, after which the two are bound up together in register, the negative image on one toning down excessively bright lights in the other as required. In binding up such slides it is better to put the mask outside, the two films being just moistened at the four corners with a touch of gum; they are put together and carefully adjusted in the usual way. Toned slides are generally improved by being varnished before they are bound up; ordinary negative varnish answers excellently for the purpose.

While the opportunities of "dodging" a slide are not by any means so extensive or so varied as with a print, a great deal more can be done than many slide-makers seem to realize. Shading during exposure is possible whenever the photographer can see between the lens and the lantern plate, but when a slide-making camera is used this is impracticable. Then the finished slide can be locally reduced by means of a physical reducer, such as Baskett's "Globe polish" (see p. 314). Mr. Wild, who has been very successful as a slide-maker, states that with a piece of flannel moistened with "Baskett" fairly large areas may be rubbed down evenly and quickly. If care is used, there is little risk of scratching, and with practice light and atmosphere may be rubbed into an evenly tinted sky, or one or two well-placed touches may give life and texture to a flat expanse of water. For smaller areas the flannel may be folded two or three times, and used edgeways. For still smaller portions a piece of soft cork cut to a convenient shape may be used, and for smaller still, a wooden match, which should be cut to a blunt chisel edge, and the sharp edges rubbed off with a piece of fine glass paper. Another method of reduction, a chemical one this time, is by the use of—

Saturated solution of iodine in alcohol	1 part
Saturated solution of potassium cyanide in water ...	2 parts
Water	Quantity sufficient

This, be it observed, is very poisonous. "By reason of its clean working," says Mr. Wild, "it can be used, if necessary, with a brush on the dry film, and so affords an easy means of completely taking out any portion, leaving a sharp clean edge." He also states that it does not alter the colour even of

warm-toned slides, and may be used, if desired, for general reduction.

The finished slide has got to be mounted with a cover glass to protect its film before it is ready to be shown in the lantern. In public that is, for in private no slide ought to be mounted until it has been seen in the lantern and thought worthy. Black-toned slides may be judged, after a fashion, by looking through them at a sheet of white paper, but any other colour—never. The appearance in the hand is no guide to the appearance on the sheet. Photographers starting out to make lantern slides for the first time have been known to purchase cover glasses as well as lantern plates; it certainly saves the trouble of cleaning the film off the defective slides, but is not otherwise economical; and he is an exceptionally skilful worker or else an easily satisfied one who can get six slides worth mounting out of a box of twelve plates. This is not to say that the process is exceptionally difficult, quite the contrary; but rather that when all the arrangements are made, it is such a little trouble to make a second or third slide, and costs so little for material, that the photographer is certainly justified in doing so, if he thinks he can get in any way an improved result. The first stage in mounting is masking. Masks can be purchased, neatly cut out of thin black paper, and if a sufficiently large assortment of sizes is obtained there is little difficulty in getting one to fit each slide. If there should be any, a strip of black binding paper will put things right. It may be taken as a general rule, to which exceptions must be extremely rare, that the best mask is one with a rectangular opening and perfectly straight sides. Circles, domes, cushions, ovals, squares with or without rounded corners are unsuitable. In arranging a picture on the ground glass, we instinctively do so with reference to the boundaries of the glass itself, or without reference to any particular form. Hence to show such a picture subsequently, in a shape which is either actively unsuitable or at least noticeable, is to weaken the effect of the picture by diverting attention to its shape. A circle or oval is sometimes permissible, if the picture has been expressly arranged to suit it, but not otherwise. The other shapes are too assertive to be used at any time. Many workers mask each slide by means of four strips applied separately, but it is not easy to get true right angles in

this way. After masking, the slide should be thoroughly dried, and the cover glass also, unless it is of bare glass, and the two are then brought together and bound with the gummed silk or paper strips sold for the purpose, attaching two strips to opposite ends of the slide and then the other two when those first applied are dry. Silk strips last longer than paper, but are not so easily applied. It only remains to attach two circular spots of white paper to the glass at the top corners facing the eye, when the view seen on looking through the slide is the right way round and the right side up. These are a guide to the lanternist, and enable him to put the slide into the lantern in the one position which, out of the eight possible, is the only one which will bring the picture in the proper aspect on the screen.

Lantern slides are generally accepted as the means by which photographs can best be shown to large audiences, but it is a great mistake to limit them in this manner. The error is due to the attempt to use too large a screen, which entails the necessity of employing an unnecessarily powerful light. For ordinary displays at home, a screen 4 feet each way, if good, is all that is wanted, and portable screens, rolling up into a very small space, can be used. Generally speaking, a "sheet" will not do, as it is not opaque enough and is very wasteful of light. The most convenient portable screen is one shown in Fig. 32. The two uprights are hinged where they join the box and fold down and form its lid. The box contains the screen which is wound on a spring roller, and is set up in a moment by lifting the bar attached to one end of the screen and catching its ends in the notches in the uprights, as shown. A better screen still for home use is made by getting a frame-maker to construct a picture frame of plain dark moulding, such as is used in house decorating

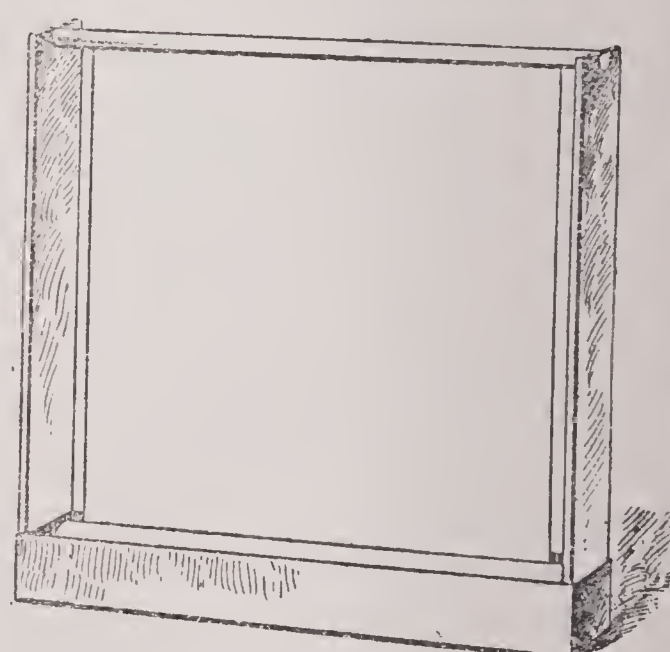


FIG. 32.

rather than for picture framing, and also to make a board which shall fit in behind the moulding in place of a picture. The front surface of the board must be planed quite smooth, and should receive two or three coats of white paint. The paint surface is not a good one to receive the slides, but is the best basis for a smooth layer of white paper which is pasted down on it before the board is put into the frame. When this gets soiled it is very little trouble to replace it with fresh. Such a screen, 4 feet each way, can be hung on the wall for use, like a picture, but its lower edge should not be more than 2 feet from the floor. With a good lantern lens and a suitable condenser, lantern slides may be projected on to such a screen with ordinary incandescent gas, with perfect success and no sense of a deficiency of illumination. But to do this, the room must be perfectly dark, the lantern should be efficiently light-tight, and there should be no white disc thrown on the screen ; it should never be seen unless either it bears a picture or is dark. The pleasure of a little lantern exhibition on these lines must be experienced to be appreciated. There is no "crick" in the neck from gazing upwards at gigantic pictures on a colossal screen ; no heat or smell from limelight in a lantern that is on the point of bursting into flames ; no sense of the ridiculous or even of the horrible from the magnification of little things to many times life-size. One's friends may sit comfortably round and view at their ease, pictures neither out of scale nor dazzlingly bright and hard. There is no doubt the lantern is the way to show photographs, and those who fail to appreciate this should see a lantern show well done, on the lines indicated.

CHAPTER XIX

ORTHOCHROMATIC AND COLOUR PHOTOGRAPHY

The ordinary plate insensitive to yellow and red—Not an unmixed evil—Colour contrast—Pure and impure colours—Two classes of orthochromatic plates—Light filters—Measuring their effect—Screened plates—Colour photography—The only "direct" process, the Lippmann—Colour vision—The Young Helmholz theory—Three-colour work—The lantern and photo-chromoscope—Coloured lights and coloured pigments—Methods of "printing"—Screen-plate colour photography—The Joly process—The Autochrome and other commercial forms—Uto paper.

IN an earlier chapter the use of orthochromatic plates has been referred to, but nothing was said as to the details of their manipulation. It was at a very early stage in the history of photography that the inconveniences of the irregular sensitiveness to different colours of all photographic preparations were experienced; but nothing of importance was done to remedy it, until Dr. H. W. Vogel found that the addition of certain dyes to the sensitive silver salts made them far more sensitive than they were otherwise, to yellow and red. It is on this basis that all modern commercial orthochromatic plates are prepared, although Sir William Abney succeeded, many years ago, in preparing an undyed collodion plate sensitive to the extreme red.

If the insensitiveness of plates to yellow and red is sometimes troublesome, it is far more often a very good feature of which the photographer takes full advantage, by using light of those colours in his dark room; and we must not forget that when we have the perfect orthochromatic plate, the plate which will give us true rendering of all colours in monochrome without any light filter, we shall have a plate that must be manipulated in perfect darkness. And that will not be its only doubtful virtue. Colour contrasts will disappear entirely in our photographs, and the photographer will have to pay much more

attention to a subject which at present he can largely ignore. An example will serve to make this point clearer.

Let us imagine we have a draught-board, whose squares, instead of being white and black, are respectively blue and red, of exactly the same intensity. To the eye such squares would be almost, if not quite, as visible as if they were black and white, though we should be unable to say which was intended to represent the lighter series of squares. With a perfect orthochromatic plate the photograph of such a board would show no signs of its divisions into squares at all, but, as both colours were of equal intensity, the board would appear of a smooth, even tint all over. This is an extreme case, and one which could only be brought about deliberately and with much trouble; but it will serve to show one of the directions in which the perfect orthochromatic plate might not be all that was wanted.

The ordinary or non-orthochromatized plate is extremely sensitive to blue and violet light, so much so that any object of a very intense blue colour photographs almost like white. Violet also, so long as it is true violet and free from red, photographs far lighter than it appears to the eye. Green, on the other hand, appears much too dark in a photograph, while pure yellow, and still more pure red, appear practically as dark as absolute black. To take a very common example, an orange placed on the customary greyish-black focussing cloth, and photographed on an ordinary plate, appears in the print almost as dark as the cloth itself, yet to the eye the fruit stands out as a brilliant high light. This is an exceptional instance, the skin of the orange being of a particularly pure colour. The great majority of the colours in nature are far from pure, but, when analyzed, show themselves to be subtle compounds made up of many tints, some of them quite unsuspected. Then, again, most natural objects have a surface which reflects a great deal of white light, foliage being a case in point; and this white light will affect the plate, even if the object from which it is reflected is of a colour to which the plate is insensitive. These and other considerations prevent the non-orthochromatic nature of the undyed plate from being the unmitigated nuisance which, under less favourable circumstances, it would be. Still, at times it may yield a result that is absurdly false. Highly coloured

flowers and insects are often impossible of transcript without orthochromatic plates, as, of course, are paintings and many artificial productions.

The insensitiveness of the plate to red is not usually very important, as pure red is so uncommon as to be met with scarcely at all; in addition, red is not a colour of great luminosity. With yellow it is different. Yellow, to the eye, is the brightest of all the spectrum colours, and a comparatively pure yellow is not an uncommon colour. Green provides still more of a case in point. Green is often almost as bright to the eye as yellow, while in outdoor nature green vastly predominates. Moreover, the ordinary plate is even less sensitive to green than it is to yellow, so much so that it has been suggested that green instead of yellow or red glass should be used for the illumination of the dark room.

Plates orthochromatized to get over these drawbacks are now issued by almost every maker, and although these plates differ amongst themselves, they may be divided broadly into two classes: those that are treated so as to be more sensitive than otherwise to green and yellow, but still not so as to be very sensitive to red; the other those which are sensitive to red also. Plates of the former class can be used in dark rooms lit by red light, with but very little more precaution against fog than would be required with extra-rapid non-orthochromatic plates; those of the latter class must either be worked by specially prepared glasses in the lamp, which generally allow so little light to pass that the only thing to be seen in the dark room is the lamp itself, or must be worked in total darkness. A "safe light" for red sensitive plates has been termed a "modified darkness," while one writer, with picturesque exaggeration, said his lamp gave so little light that when he shut his eyes the room brightened up considerably. Red sensitive plates have done much to make time development a necessity.

Whatever the method of orthochromatizing may be, it always, so far, has failed to make a plate as sensitive to yellow and green as it is to blue and violet, and as both yellow and green to the eye appear the more luminous, something more must be done if the orthochromatic plate is to show a result noticeably more truthful than can be got with an ordinary plate. This something is the use of a colour screen or light filter, a

A WATER BYE-WAY

BY MRS. WOOTTON

transparent coloured glass or filter which, by stopping some of the light to which the plate is unduly sensitive, but allowing all to which it is insufficiently sensitive to pass, goes some way to correct the error in colour rendering, still present with the orthochromatic plate.

By the use of a suitable light filter a very fair rendering of green and yellow objects can be obtained on an ordinary plate, but the exposure is increased to such an extent as to deprive the method of any particular value. Mr. Arthur Payne some years ago published two illustrations to show this. Both were taken on ordinary plates, one without a screen, the other with a yellow colour screen, which increased the exposure from half a second to an hour. The result was a very fair rendering of the subject. Had an orthochromatic plate of the same general speed been employed, the half-second exposure without a screen would probably have been a little but not much better than on the ordinary plate; but a light filter could have been made which would have given as good a result, if not one actually better than that obtained with the hour's exposure, but calling for an exposure of not more than five or six seconds. In other words, at least as good a result can be got on an orthochromatic plate with a screen increasing the exposure ten times as can be got on an ordinary plate with a screen calling for several thousand times the exposure; both plates without a screen being of about the same rapidity.

As the colour screen to be of any service must cut off some of the light to which the plate is sensitive, it necessarily lengthens the exposure. The extent to which it does this depends upon the nature and depth of the colour of the screen, the colour-sensitiveness of the plate, and the character of the light. This last consideration greatly increases the difficulty of determining the increased exposure a screen requires, since in the white light of midday the proportionate increase is much greater than in the yellow light of a late afternoon, or of most forms of artificial illumination. In fact, for work with artificial light a colour screen is seldom needed.

For hand-camera work, any colour screen at all is only possible either when the conditions are very favourable, as in photographing open landscapes with no heavy foreground shadows, or else when the apparatus is provided with a very

fast lens and a slow shutter. The introduction of a dye known as "Filter Yellow K," which is particularly suitable for colour-screen work, has made it possible to prepare screens which give a very fair correction for a comparatively small increase in the exposure. Thus in the "K" series of screens, which are prepared by Messrs. Wratten and Wainwright, the weakest of these, known as K1, when used with orthochromatic plates of the ordinary kind calls for an increase of exposure not more than three times, or if a "panchromatic" or red sensitive plate is used, the increase is only double. The K2 screen requires twice or three times as great an increase, while the K3 screen, which is made for use with the panchromatic plates only, increases the exposure six times, but gives a rendering which is practically correct throughout. Of these screens, the K1 with a panchromatic plate can be used under most of the ordinary hand-camera conditions quite successfully; while we have used the K3 for hand-camera work, with a lens at F/4·5, without finding that the exposures were so long as to make a stand a necessity. For such purposes, however, the shutters fitted to most hand-cameras are not slow enough, or rather are not controllably slow enough, to be of much service.

For landscape and similar work for which a stand can be used, the K3 screen is certainly the best, if the panchromatic plates are employed; if not, the K2 will do very well, and will give a rendering very much more correct than could possibly be obtained on ordinary plates. For strongly coloured subjects, where correct colour rendering is of great importance, as for example in picture-copying, a panchromatic plate and a K3 or similar screen becomes a necessity. Such a combination also presents very great advantages in certain special work, as for instance in photographing polished mahogany furniture, as some examples by Messrs. Wratten and Wainwright have shown. Photographed in the ordinary way, the bright reflections from the polished surface completely hide all signs of the pattern of the wood; whereas when photographed so that the colours are correct, the reflections take quite a subordinate place, and the beauty of the woodwork is rendered with the same clearness as it is seen.

Correct colour rendering would be a very great gain in portrait work, beyond question, since much of the retouching

which is necessary in portraiture is due to the way in which the non-orthochromatic plate exaggerates any slightly yellow or red freckles or spots on the skin. It has even been said that attacks of skin disease have been detected by the spots being visible in a photograph some time before they were to be seen on the skin itself; and it is quite possible that something of the sort may have happened, although I have never been able to fix the date and locality of any actual occurrence. The difficulty about colour correct portraiture is that it would necessitate the exposures being increased to at least six times their present length; and although in a well-illuminated studio this by no means makes it impracticable, still the increase is one which most portrait photographers would regard as a serious inconvenience, as many would the use of red-sensitive plates and the dark-room modifications which they impose. The fact remains that comparatively few orthochromatic plates are used in the studio, and we do not know of any professional worker who has habitually employed them with a colour screen for portraiture.

An important departure has been made in recent years by the introduction of orthochromatic plates which have had the dye-stuff of the colour screen incorporated in their emulsion, so that no separate colour screen was a necessity with them Such plates are known as "Anti-screen" or "Self-screened" or "Screened" plates, or by some similar title, and are supplied by several makers. They have come into considerable favour for landscape and general amateur photography, chiefly because while they give a decidedly better rendering than an orthochromatic plate of the usual type without a screen, they do so with only a slight increase in the exposure necessary, and without any of the bother, real or supposed, which the screen itself entails. There does not appear to be any actual gain in sensitiveness. If a screen of any kind is used, it must prolong the exposure; and if a screened plate proves to be nearly as sensitive as the fastest unscreened plate, it is safe to conclude that the screening action can only be comparatively feeble. It may be enough for most purposes, but it cannot be extensive. No screened plate we have used has given as good correction. as can be obtained with the same maker's unscreened orthochromatic plates used with a separate five times colour screen.

The comparative feebleness of the screening is not altogether an objection. Were it more complete, it would make the plates very much slower; and it must be remembered that the screen on a "self-screened" plate cannot be removed. So that such plates would be out of the question for most work with a shutter, such as hand-camera work; whereas at present they are not so thoroughly screened as to make them too slow for such purposes, while, when a more perfect colour rendering is required, there is no reason why, with such plates, an additional colour screen should not be used in the usual way. The fastest screened plates, in ordinary daylight, are about two-thirds as fast as the fastest unscreened plates.

Colour screens are made in various ways. The colouring matter is now almost always a dye, which is used to stain either a gelatine or a collodion film. At one time screens of coloured glass were used, and there are still a good many about. They gave a very fair colour correction, but were open to the objection that in proportion to the correction they increased the exposure unduly. This they did because the glass is not a true yellow, but a yellow-brown, as can be seen by putting such a screen on a sheet of white paper. The brown was due to an admixture of black with the yellow, and while this black, cutting down light of all colours indiscriminately, did not interfere with the correction exercised by the yellow, at least it made a longer exposure necessary. For many years liquid light filters were extensively used in America, though they never were popular in Europe. These filters consisted of a glass trough or cell, which could be filled with a suitably coloured liquid. The solutions used with them were chiefly those of potassium bichromate, potassium chromate, naphthol yellow, and ammonium picrate. Such screens have also been used in three-colour work. Their place has been taken almost completely by the screen of dyed film.

The dyed film, being very thin, may be used in the lens just as it is, without much fear of the corrections of the lens being affected; and such film screens can be obtained very cheaply. If the lens is one of old-fashioned type, fitted for Waterhouse stops, a simple fitting to take the screen may be made of thin blackened card. This is folded over so as to be of double thickness, and is then cut out in the shape of one of the stops,

with an opening of the desired size: the fold should come at the bottom of the stop, that is in the part which is first put into the lens. When cut, it is opened out and the film of dyed gelatine is inserted between the two halves; and it can then be slipped into position. It is quite easy to make a little cardboard ring to fit into the mount of the lens, when this has not Waterhouse stops, and to attach a circle of the film to this ring, so that it is held close to the iris diaphragm. This is the best place for a screen of this kind. Other methods of fitting such screens will no doubt occur to the reader. The screen of film is very easily injured. It is apt to buckle and warp with changes in the moisture of the air, and the slightest fingering of it leaves indelible marks, which, when present in any numbers, have the effect of scattering the light and so making it difficult to get clean, strong negatives. Except for purely temporary purposes, therefore, it is better to have the screen protected by being cemented between two pieces of glass. For most purposes ordinary glass can be used, if it is carefully selected, so as to be as flat and true as possible; but for telephotographic work with high magnifications this is not good enough, and in certain other cases there is a possibility of such glass impairing the definition of the lens, and it then becomes necessary to have the film cemented between "optical flats." This is the name given to glass which has had its surfaces ground and polished flat with the same refinement that is used for the curved surfaces of a lens. In some cases it is possible to put the colour screen between the source of light and the object, instead of between the object and the plate. It comes to the same thing in the long run, as far as colour correction is concerned, and is often employed in photomicrography. The quality of the glass of the colour screen in such a case is not important.

The actual position occupied by the colour screen is decided more by convenience than by anything else. We have seen that it may be actually incorporated with the plate itself. It could also be used in the dark slide immediately in front of the plate, just behind the lens, between the combinations of the lens, just in front of the lens, or between the light and the subject. A screen of bare film may be used between the combinations of the lens, but it is best not to insert a thickness of glass in such a position. If the screen is used between the lens

and the plate, it will be found that it slightly alters the focus of the lens, lengthening it by about the thickness of the glass composing the screen. It is necessary, therefore, either to focus with the screen in position, or else to allow for this alteration afterwards. Otherwise this is the best place for the colour screen, as it is less exposed to scattered light than in front of the lens. It is in front, however, that it is most frequently used, as it is more easily put on and off, and does not, or at least should not, alter the focus when in position.

As some dyes which are in other respects very suitable for colour screens are liable to fade in the course of time if exposed to a strong light, the screen when not actually in use should be kept in its case. Screens made with "Filter Yellow K" are not liable to fade. The screen should be cleaned with the same care as the lens, as any loss of polish or scratching on its surface is just as injurious as if it were on the lens, except, of course, that it is less costly to replace the screen. It is important to the user to know as exactly as possible the extent to which his colour screen necessitates an increase in the exposure. It is not enough to rely upon the selling description "three times," "six times," or whatever it may be. At the best these are only rough approximations, often hardly that; while, as we have already seen, the increase depends not only on the colour of the screen but also on the nature of the plate. Although there is a family likeness between the various ordinary orthochromatic plates (that is to say *not* the red-sensitive variety) on the market, they differ considerably amongst themselves as to the increased exposure required with any particular colour screen. To ascertain whether the seller's description is correct, plates should be exposed one with and one without the screen, preferably on a black-and-white subject, as for example a crumpled white cloth, or tuft of cotton-wool laid on a black focussing cloth. If the screen is said to be a "four times" one, we may give one plate the exposure known to be correct, and the other three separate exposures, one say three times, one four times, and one six times that of the other. This can be done by pushing in the shutter of the dark slide a little at a time. If the correct exposure is not known, it may be found out by exposing a trial plate in a series of steps in the same way. The two plates, one with and one without the screen, must be developed side by side

in the same dish for the same time, and only after they have been fixed, washed, and dried, should they be compared. It will then be seen which increase in exposure is nearest correct. In deciding this it is important to judge only by such parts of the plate as have evidently been properly exposed ; any other criterion will be found misleading. It is usually more important to try longer exposures than those for which the screen is nominally provided, rather than shorter ones, as there seems to be a tendency to underestimate the increase required: at least, we have not come across a screen at any time with which this was overestimated.

A phrase which is much used by some workers is "over-corrected," by which they mean that the colour screen used has carried the remedy too far, so that red, yellow, and green, instead of coming out too dark, as they do without a screen, come out too light. Instances of this fault are extremely rare ; in fact, we doubt if we have ever seen an example, except one made for the purpose. Most cases of "over-correction," so-called, are not actually such at all, but are due to the increase in the exposure not having been long enough to give a properly exposed plate. The result has been that the plates have been over-developed also, and, as a result, the lighter tones have been made too hard. In addition to this, some allowance must be made for the fact that photographers are apt to be influenced in their judgment of correct colour rendering by the many incorrect photographs which they see, and so have a tendency to underestimate the lightness of tone of such things as grass, foliage, etc., which they habitually see rendered too dark. Over-correction is a fault which it is so unlikely any photographer will commit, that he hardly need be cautioned against it.

The development of orthochromatic plates (other than red-sensitive) does not present any particular difficulties. It is true that the plates are more sensitive to the red and yellow light of the dark room than ordinary plates are, but the increased sensitiveness is not so great as to be an inconvenience if reasonable care is taken not to get fog. The dish, of course, must be kept covered all the time, except just at the moment of observation ; and it is well not to let any of the direct light from the lamp fall on the plates while the dark slides are being loaded or unloaded. The light itself should be red, not

yellow, in colour, and should be one of the "safe-lights" specially made for the purpose, and not merely a piece of ruby glass. It has been observed that the action of a developer which contains sodium sulphite is to desensitize the plate for colour to some extent; so that after it has been in such a developer for half a minute or more, it is much less likely to be fogged than before; and it has even been suggested that plates should have a preliminary bath of some solution containing sulphurous acid for this purpose. The protection is a doubtful one, however, and should not be regarded as an excuse for anything less in the way of care against unnecessary exposure to the dark-room light, or there may be fog. The dye which is added to the emulsion to make it orthochromatic gives such plates a very distinct colour before development; and the screen dye in screened plates gives a further colouration. Most of this is lost in the developing and fixing, however, although there is sometimes just a trace of colour perceptible in the finished negative.

Panchromatic plates, being specially sensitive to red, call for much more care in the dark room. In fact, they are altogether more prone to suffer from fog, although with proper precautions the negatives on them can be kept as clean as one can wish. Some workers advocate green light for the dark room when these plates are used; but it is much better to face the subject boldly, to load and unload the camera in complete darkness, and to develop in a light-tight tank, or in a covered dish, by the time method pure and simple. This is greatly facilitated by the practice of the leading makers of panchromatic plates, who enclose in each package a statement of the correct times of development at various temperatures, with various recommended developers. They usually add to this data as to the precise increase of exposure which that particular emulsion requires, with various standard colour screens. The backing on panchromatic plates, since they are sensitive to all colours, is generally black; but the usual red-brown caramel backing will be found very nearly as efficient.

To sum up the requirements of the various classes of work in this direction, it may be said that inasmuch as it is not possible so far to make orthochromatic plates quite as fast as the fastest non-orthochromatics, the latter should be used

wherever the very utmost possible speed in daylight is required. Late in the day when the light is yellow, an orthochromatic plate may prove to be faster than its rival, as it is almost sure to be to the various artificial lights, except to some arc and mercury-vapour lamps. For landscape and architectural work generally, ordinary, orthochromatic, and screened orthochromatic plates may be used, according to the fancy of the worker. For Alpine work, and for views generally in which there are great distances, as well as for clouds against blue sky, an orthochromatic plate and screen are a necessity if the rendering is to be anywhere near correct. For flowers in general, the opinion of most experts is in favour of orthochromatic plates without a screen, except in special cases, such as of deep-red flowers, when a screen may be obviously necessary. Most professional portrait plates are not orthochromatic; though some of the cleverest portraitists recommend orthochromatic plates, but without a screen. Amateurs, who have strong reasons for avoiding any necessity for retouching, will find one of the self-screened varieties very suitable. For copying paintings, photographing polished woodwork, and for strongly coloured subjects in general, the more nearly one can approach complete colour correction the better. For black-and-white work orthochromatic photography is clearly not required; except that when artificial light of a more or less yellow tint is used, the extra sensitiveness of the orthochromatic plate becomes helpful.

One other side, a very interesting one, of this subject remains to be mentioned. While all the methods just considered have had for their aim the securing of a more truthful representation, there are times when exactly the opposite becomes necessary, and then the same methods, duly modified accordingly, can be made to give some very astonishing results. For example, let us suppose the case of a document written in black ink on white paper, over which some red ink has been spilt. On an ordinary plate without any special precautions at all, the red blot would photograph almost if not quite as black as the black ink. A panchromatic plate, with a colour screen designed to give correct rendering, would show the blot very plainly, but still much lighter in tone than the ink. If a deep enough red screen were used, however, it

would be possible to photograph the document so that the red blot was quite invisible, the paper there appearing just as white as elsewhere. This would be a case of legitimate over-correction. Or we might have to photograph some type-writing with corrections in ink of one colour or another; and by a choice of screens one could make three photographs, one showing the violet typewriting but none of the corrections, one showing the corrections but none of the typewriting, and the third showing both as plainly visible in the photograph as they were to the eye.

COLOUR PHOTOGRAPHY

Any one with no technical knowledge of photography who was asked to define what he meant by a photograph in colours would no doubt convey the idea that to him it was a photograph which reproduced automatically not merely the outlines and light and shade of the subject but also its colours. Ever since there has been photography at all there have been investigators who have sought for some sensitive substance which should respond to the action of coloured light by itself taking on that colour, or, what would come to much the same thing in practice, the negative or complementary of that colour. Although these investigations occasionally, in early days especially, gave results which seemed to be promising, we now know that such promises were misleading, and that as far as a solution of the problem of colour photography on these lines is concerned, we are just as far from it as we ever were. There has been no discovery of any kind whatever which gives us reason to suppose that such a substance exists or could be brought into existence. It may be that it will, it may be that we are on the very eve of its production; all that we can say is that there is nothing that is now known that makes this more probable than it seemed when photography itself was but a new thing.

Yet every one knows that photography in colours is an accomplished fact: although the popular impression which applies the term to the gaudily tinted postcards and views that are offered for sale at watering-places and elsewhere is as incorrect as popular impressions can be. Such things may

be collotypes or similar photomechanical reproductions of photographs, printed on card or paper on which colours have been printed by lithography, or they may be made by other variants of "process work"; but they are no more photographs in colours than they would be if the purchaser bought a plain print and then himself painted on it. We shall see later on that it is quite possible to get photographs in colours by the "three-colour process"; but as far as local views are concerned, such photographs would be too true to nature, in other words not sufficiently garish, to compete with the gorgeous aniline sunsets and metallic green foliage of the coloured view.

Direct colour photography of the kind referred to at the commencement of this chapter being at present impossible, it remains to see how indirect colour photography has been achieved. This is known as "three-colour photography" for reasons that will be evident in a moment; but before dealing with it, some mention must be made of a method of colour photography which is in a sense "direct," and has no connection whatever with three-colour work—we refer to the Lippmann, or interference process.

Professor Gabriel Lippmann, of Paris, a very able and original physicist, concluded that if an image were projected upon a photographic film in such a way that the light as soon as it reached the back surface of that film were reflected back on itself, the reflected beam would "interfere" with the direct beam, in such a way that the photographic image seen in favourable circumstances would show the colours of the original; and on trying the experiment, he found that it was so. The prepared glass plate was exposed with its glass side to the lens, and was backed up with mercury which acted as a mirror, and the result, seen at a certain angle, reproduced the colours. Unfortunately the conditions necessary for success seem to limit this to a laboratory experiment. It is interesting to note that the particular photographic process employed to obtain the result is not important; the colour photographs have been obtained on silver bromide films in albúmen, and in gelatine, and also on bichromated gelatine. What is necessary is that the sensitive film shall be practically transparent, and transparency can only be obtained at the cost of rapidity; so that any film clear enough to give a photograph by this

process at all is extremely slow, so slow as to be quite out of comparison with a plate at all, slow in fact by the standard of a piece of P.O.P. Then again the colours are not of the nature of pigment colours, which are visible unaltered at any angle, but are rather of the nature of iridescence, like the colours of a soap-bubble or of a thin film of tar on water Interesting as the process is, therefore, and unique, as the one direct method of photography in colours, it has not gone beyond the stage of an experiment, requiring great care and manipulative skill; so that specimens, which are all on glass and easily injured, are very scarce.

All other colour photography is by the three-colour process, in one or other of its many modifications; and to appreciate its nature one must realize the nature of colour vision itself. The Young-Helmholz theory of colour vision, in outline, is that all our consciousness of colour is the result of the excitation of one or more of certain colour sensations of which the human brain is capable, which sensations are three in number. There appear to be three "somethings" in the eye of every one who is not colour blind, and by the extent to which each of these is simultaneously stimulated, do we have that form of consciousness which we associate with the word "colour." Professor Clerk Maxwell who investigated the subject very thoroughly, plotted down the sensitiveness of these three somethings to the different rays of the spectrum in the form of curves, and showed that the three are respectively most sensitive to a particular shade of blue, of green, and of red. One might call such shades the three primary colours; but it is better to avoid such a term, as it was extensively misapplied before the nature of colour vision was worked out, and is likely to lead to confusion. It is better to speak of three primary *colour sensations*. All our perceptions of colour, however complex and subtle its character, arise from the way in which these sensations are excited. It is to be noted also that although, as an optical experiment, it might be possible to obtain light of a pure colour, which excited one of these sensations only, the colours in nature are very much more complex, and it is doubtful if we ever look at any coloured object whatever, that does not, to some extent at least, excite all three sensations. Our perceptions of colour vary according

to the different proportions in which the sensations are excited. Thus a yellow object, were it pure yellow, might be exciting the red and the green sensations, to the exclusion of the blue-violet; but actually, the yellowest object we are likely to look at would to some extent at least be exciting the blue-violet also. When all three sensations are excited to a certain balanced extent, we get the colour known as white. White is just as true a colour as the most pronounced cardinal, or mauve, or emerald, it should be remembered; and, as far as we are concerned, is the result of a simultaneous excitation of all three sensations in certain proportions.

Accepting this theory as a working explanation of colour vision, it remains to be seen how it can be applied to photography. Let us suppose for a moment that only one colour reaches the eye, and that on analysing its effects in some way or other, we find that it excites the three colour sensations, blue, green, and red, in the proportion of 7, 4, and 2 respectively. Manifestly we can make a record of that colour with a pencil and paper, jotting down 7, 4, and 2. At some future date, if we get three beams of light exciting the three colour sensations. and we cut them down so that their relative intensities are 7, 4, and 2, and blend them together, their combined effect on the eye will be to reproduce the identical colour originally seen. Our pencil note of the figures will contain no colour itself, but will be a record of the colour by means of which it can be reproduced. Instead of making a note by hand in this way, we can make a photographic record. For this purpose three separate photographs of the object will be needed. One must be taken through a colour screen of such a kind that it passes such light as excites one of the colour sensations, another of a second, and another of the third. As was the case with the pencil note, there will be no visible colour in the photograph; it will merely record the extent of the colour sensation experienced; but it may be utilized to reproduce the colour.

Photographs to record colour sensations in this way must be taken on panchromatic or red sensitive plates—at least one of them must be, as it has to record red rays—and, as a matter of fact, in almost all three-colour work now done, the same kind of plate is used for all three records. Often all three are

on one plate, as is invariably the case in the "screen-plate" processes to be referred to later. The colour screens or light filters used have to be adjusted with great care, so that their record may be a faithful one, and have to be suited to the particular plate that is used. There are all sorts of practical difficulties in the way of making such a set of records ; but in skilful hands they have been overcome, and the production and utilization of such negatives is now a daily operation in many places.

Let us suppose that such a set of three negatives has been made, and that for the sake of simplicity the subject contains some pure yellow light, that is to say one which excites the red sensation to a certain extent, the green sensation to another extent, but not the blue-violet sensation. In the negative which records the blue-violet sensation, the yellow object will appear as clear glass, indicating that none of the light reflected from the subject was able to pass through the blue-violet colour screen, which only transmitted such light as would excite the blue-violet sensation in the eye. In the green negative, however, there will be a deposit, showing that some of the light passed through the green screen, and the same with the red, the relative depth of the deposits in these two negatives indicating the relative intensity of the excitement of those two colour sensations. Now three lantern-slides might be made from these negatives, and put into three lanterns, and the three images all thrown upon the same sheet, putting in the path of the three beams glasses coloured red, green, and blue-violet respectively. The negative of the blue-violet, showing the yellow object as clear glass, will cause the image of it in the lantern-slide to be black. Consequently no blue-violet light will reach the screen in that place. On the other hand, the green and the red negatives will give lantern-slides in which the yellow object is more or less transparent, so that some red and some green light will reach the screen there, and the object will appear a combination of red and green, that is to say yellow. Such lanterns have been made, and very fine projections in colour can be given with them. An ingenious instrument, the "Photochromoscope," was invented by Mr. F. E. Ives, by means of which three transparencies backed up by colour screens of a suitable character could be seen simultaneously ; this gave a

very good and faithful reproduction of the colours of the original.

Both of the cases just mentioned involve the addition of *lights.* That is to say, the yellow object appears yellow because we see it by both red and green light, and red and green light in due proportion appear as yellow. Most three-colour methods, except "screen-plate" methods, involve the mixture of *pigments;* and then quite different considerations arise. One cannot get a yellow by mixing a red and a green, paint, any more than one could get white by mixing red, green, and blue-violet paint. On the contrary, we might expect to get a black instead of a white, and the result would justify the expectation. A few words should be sufficient to give a clue to the difference. Red paint put down on white paper, makes the paper red because it stops the passage and reflection to the eye of all except red light. Green paint in like manner cuts off all except green light. A mixture of red and green paint, therefore, does not give rise to the sensation of yellow, because although the green paint is allowing green to pass, it is cutting off the red, while the red paint which would let red light pass, if the green paint did not stop it, is itself stopping the green. The result is, if the red and green paints are sufficiently intense, that their admixture is a kind of purple-black. Colours in the case of pigments, therefore, are seen to be due to subtraction of lights, while in the lantern and the Photochromoscope they were caused by the addition of lights. The difference can be overcome very simply. We have seen that the yellow object which we have taken as an example, is recorded by a certain gradation in the green and the red negatives but by clear glass in the blue-violet. Instead, therefore, of printing in red and green pigments, let us suppose that we took yellow pigment and made a *negative* print from the blue-violet negative in a yellow ink. This would give us a yellow object. If we made a *negative* print in a pure blue from the red negative, and one in pink from the green negative, we should find that by thus printing in "minus colours" as it has been termed, we can get a faithful reproduction of the original. This fact is the basis of three-colour work on paper.

The actual printing can be done in several ways. It is possible by a modification of the carbon process to obtain

gelatine impressions from the three negatives, which impressions can be soaked in suitable dye, which they will absorb, and then these three dye images can be transferred to one and the same film, so that if all three are carefully superposed the result is a colour picture. The pinatype process is of this nature. Thin films bearing carbon pictures in the three colours may be superposed and bound up together in the form of a lantern-slide; or the three carbon pictures may all be transferred to one support. Mr. Sanger Shepherd has produced some very beautiful lantern-slides by working on these lines, and has designed a camera (there are other such) by which all three negatives can be made on one plate with a single exposure. The blue picture, which it will be remembered is a negative print from the red negative, may also be printed by the blue print process, and the other two images may be carbon prints. Or one may print from separate half-tone blocks in three suitable inks, or collotype may be used in much the same way. This method is now extensively used in book illustration; but it is usual to print from a fourth, or "key" block, in black, in addition to the three impressions in colour. Thus the frontispiece of this volume is itself a three-colour photograph of an original in colours; the original being made by oil printing as described elsewhere, while the frontispiece is made by taking three separate negatives and printing from half-tone blocks in suitable inks.

The greatest development of the three-colour process is in the direction known as "screen-plate" photography. Professor Joly, of Dublin, worked out the first of these methods; but it was not until the "Autochrome" plate was introduced by Messrs. Lumière that the photographic world awoke to the wonderful possibilities of such a process. In the "Joly" plate a piece of glass was ruled with a series of fine lines of some strongly coloured varnish, the lines being respectively violet, green, and red. A panchromatic plate was exposed in the camera with its film in close contact with the ruled surface of the glass, so that all the light coming from the lens had to pass through the rulings to get to the plate. The result was that instead of making three separate negatives for the three colour sensations, the three records were all made on one plate, a kind of tricolour sandwich, composed of a series of fine lines. When

a transparency was made by contact from such a negative, and the transparency was carefully adjusted upon such a ruled screen so that the lines of which its image was composed exactly registered with the lines of the ruled screen which gave rise to them, the transparency was seen to present the colours of the original. It had to be viewed from such a distance that the lines of which it was built up blended together. The cost of ruling such screens, and the difficulties of making them with any degree of fineness, caused the Joly process to remain little more than an interesting curiosity.

The "Autochrome" plate dealt with the same problem in a wonderfully ingenious and successful manner, and for the first time made it as easy and simple to produce a transparency in correct colours as a black-and-white negative of the ordinary kind. Starch is a vegetable product which consists of fine grains, the size of the grains varying with the origin of the starch. Thus potato starch may be obtained consisting almost entirely of particles of one definite size. Three lots of such starch grains are dyed violet, green, and red respectively, and the strongly coloured powders so obtained are mixed together in such proportions that none of the colours predominates, the whole mixture having a neutral tint. A sheet of glass being coated with some adhesive, this powder is dusted over it, and when dry is rolled, to flatten out the starch particles and fill in all interstices, and is given a coating of protective varnish. This constitutes the "screen-plate" in the Autochrome process, and is exactly analogous to the Joly ruled screen: differing from it by being made as it were *en masse* instead of by separate ruling, and by having its violet, green, and red particles scattered promiscuously instead of in lines, and being very much finer. The flattened starch grains in the Autochrome plate average about one two-thousandth of an inch in diameter, which is far too small to be seen with the naked eye, although when a number of the same colour get together they can be distinguished without a magnifying glass. It is not practicable to place a panchromatic plate in contact with this screen-plate for exposure, and then, making a transparency from the negative so obtained, to superpose it on the screen and get the colours. The particles of starch are too small to allow of this to be done. Instead, therefore, the screen-plate itself is coated with a panchromatic

emulsion, the picture is taken on this, turning the glass side of the plate to the lens, and then, after a negative has been developed, instead of fixing it, it is converted into a positive picture *in situ*, by a modification of a well-known process, so that the picture, never having been moved, all registration difficulty is got over at once. Such is the Autochrome process in outline.

This remarkable advance was made public in the summer of 1907, when for the first time it became possible to produce transparencies in colour by a single series of simple operations, the whole production of a finished Autochrome taking less than an hour from the time of exposure of the plate. The ease of working and the beauty of the results, which in fidelity of colour-rendering far surpassed anything that until then had been done, aroused a widespread interest, and set many other experimenters working; but for some years the Autochrome was without a rival. Then a plate known as the "Thames" plate was produced, in which, by an ingenious utilization of the half-tone process screen a glass plate was impressed with a perfectly regular pattern of red and green discs upon a violet background. A few such plates appear to have been made coated with emulsion, as in the "Autochrome," but they were put forward chiefly for use with a separate plate, a transparency being made and placed down in register upon the screen-plate. This it was possible to do on account of the comparative coarseness of the image, the diameter of the discs being about one three hundred and fortieth of an inch (at least six times linear, or thirty-six times the area of the starch grains in the Autochrome). The "Thames" plate was eventually dropped; but its transparency and mechanical perfection were undeniable, and are found in the "Paget" screen-plate of the same inventor. In this also the glass has a regular pattern of colours on it,

G	V	G	V	G	V
V	R	V	R	V	R
G	V	G	V	G	V
V	R	V	R	V	R
G	V	G	V	G	V

in a series of little squares which run in parallel lines, the squares being arranged as shown in the diagram on the previous page. The Paget Prize Plate Company, which issues these plates, together with a special panchromatic plate for use with them, supplies two kinds of screen, which, however, do not differ to any great extent. One is the "taking" screen, and the other the "viewing" screen; their purpose being sufficiently described by their title. Other screen-plates with a mechanical grain are the "Omnicolor" of Messrs. Jougla (no longer manufactured), and the "Dufay."

The "Autochrome" plate, in consequence of the extreme fineness of the starch particles of which it is composed, is coated with an emulsion of a kind which is distinctive. It forms an extremely thin layer on the plate, and the reversal of the image is easily accomplished. A special colour screen must be used on the lens, and it may be pointed out that this screen should be protected from light when it is not actually in use, as it is not permanent. After developing the plate, for which purpose pyro-ammonia or metol-quinol are recommended, it is placed direct into a reducer composed of a solution of potassium permanganate acidified with sulphuric acid. This almost immediately dissolves away the image just developed, leaving the undeveloped silver-bromide, which, now that the developed image has been removed, is a positive one. (If instead of this the Autochrome when developed is placed in hypo and fixed, we still get a picture in colours; but the colours are the reverse of what they were in nature—they are the complementary colours, in fact. This forms an interesting and instructive experiment, and every user of the Autochrome process should make at least one plate of this kind.) The positive image consisting of silver-bromide is white in colour and not very intense, but by putting it back into the developer it can be blackened, and, after washing, the Autochrome may be considered as finished. If the colours are not strong enough, it may be intensified with pyro and silver nitrate; but this process, although originally advocated for every plate, is now considered as only occasionally necessary. It is usual to varnish Autochromes either with a solution of gum dammar in benzol, or with a celluloid-acetone varnish. A varnish containing alcohol cannot be used.

The Autochrome process gives us a finished transparency in

colours. If we wish to duplicate it, the object may be photographed again on another plate, or, the Autochrome being fixed up and illuminated from behind, it may be copied on to a fresh Autochrome plate in much the same way as a lantern-slide is made by reduction. It has been said that there is a great falling off in the brilliancy of the colours when this copying is done ; but although there must, theoretically, be some degradation, it can be kept down by the exercise of reasonable skill in exposure and development, so that one should not be able to detect a copy by any want of brilliancy. In the case of the "Paget" plates, since the taking and viewing screens are separate, having made a negative through a taking screen, one may make just as many positive transparencies from it as may be required or as there are viewing screens for use with them. Since all the taking and viewing screens are exactly alike in the scale of the coloured pattern on them, only one taking screen is necessary for any number of pictures. As the plate and screen are separate in this process, it becomes important to press them up into close contact at the time of exposure.

The emulsion on the Autochrome plate is highly sensitive ; but in consequence of the depth of colour in the screen-plate, and the special light filter which is an absolute necessity on the lens, the exposures are comparatively long. The plates have been used in a hand-camera, but it is only in exceptionally favourable conditions both of light and of subject, and with a very rapid lens (F/3 or F/4), that so short an exposure as the tenth or sixteenth of a second is possible with them. To overcome this, methods of increasing the sensitiveness of the emulsion by bathing it before exposure with certain dye solutions have been tried, and found very effective. Special solutions can be obtained in which the plates are immersed, whirled to get rid of the excess of solution, and then dried in a drying box with calcium chloride. The dried plates, in consequence of their altered sensitiveness to colour, have to be used with a special form of colour screen, and are then about five times as fast as before. They retain this extra rapidity for three or four weeks, but then gradually lose it again. With the aid of specially powerful flash powders, portraits at night are possible on Autochrome plates: but in such cases, also, a special colour screen has to be used.

The Paget colour plates require less exposure than the Autochrome, the relative rapidity being about 1 to 3, or 4. As there seems to be little difference in the tendency to fog in the dark room, the shorter exposures required by the "Paget" are presumably to be attributed to the greater transparency of the screen-plate, which is decidedly lighter than the Autochrome. This difference is seen also when colour transparencies on the two plates are seen in the lantern: the Autochromes give a very, perfect rendering of the colours, but a more powerful light, or what comes to the same thing, a less magnification, is needed to give them with equal brightness.

All these screen-plate processes give as the final result a transparency on glass, which the uninitiated will persist in calling a "negative," although, of course, the result is not a negative at all, but a positive. Many have been the attempts to produce paper prints from them. The "Paget" Company worked out an ingenious method of making a transparency on a specially thin viewing screen and backing this up with paper with a bright metallic reflecting surface. The results looked like paper prints under glass; but there was necessarily a great loss of brilliance. The best method up to the present is only available when a large number of copies are required, and resolves itself into the reproduction of the colour transparency by means of three colour half-tone. Some of the "nature" books which are now illustrated in this way show that a remarkably high degree of perfection has been obtained.

The aim of the inventor is to produce a sensitive paper which, placed under a glass transparency in colours, will give a colour print, just as a piece of P.O.P. under a negative will give a plain print. Although no very high degree of perfection has yet been reached in this direction, some very wonderful results, considering all the difficulties, have been obtained. Dr. J. H. Smith succeeded in preparing a paper, which was on the market under the name of "Uto" paper. Its coating was of a greyish-black colour, and when exposed to light of any colour it gradually faded out until it had taken a tint approximating to the colour of the light to which it was exposed. Thus, if it was placed under an Autochrome to print, the result was a very fair reproduction of the stronger tints of the Autochrome. The Utocolour Company, which made the paper, supplied certain

solutions for use with it, by which the print could be, in a measure, fixed. Exposed continuously to a strong light, such prints continue slowly to fade; but if kept in a drawer or portfolio, and only occasionally taken out into light, they seem to be permanent enough. We have some which have been made over eighteen months and kept loose in a drawer without special precautions of any kind, and are still apparently quite unaltered. The paper is no longer obtainable.

The principle on which this paper was made is one of the many modifications of the three-colour process. Whenever work of any kind is done in a film by means of light, light is absorbed and disappears as such. Thus in a dry plate in the camera, the light that actually effects the emulsion and gives rise to the developable image is absorbed by the film. It follows that such a thing as an absolutely transparent light-sensitive substance is an impossibility. If it were perfectly transparent it would absorb no light, and if no light were absorbed no work could be done. When the colour in a dyed object fades out on exposure to light, work is done by the light, that is to say the dye is bleached. That work is done by the light which is absorbed by the dye, and the dye absorbs light of all colours except that of its own colour. For instance, a red object is red because the dye which colours it absorbs the light of all colours except red, so that only red light is left to reach the eye. In the same way a green dye absorbs all but the green rays, and violet all but the violet. Now let us imagine a film or coating on paper stained with violet, green, and red dyes all three of which happen to fade very easily, and see what happens when such a film is exposed to light. If it is violet light only to which it is exposed nothing will happen to the violet dye in the film. Violet dye absorbs light of all colours except violet, but as the light to which it is exposed is violet there is nothing such dye can absorb, so that the violet dye remains unaffected. The green dye, however, which absorbs all but green, absorbs this violet dye, and work is done in the green dye by the light it has absorbed; in other words, the green dye exposed to violet light absorbs it and so fades. In the same way the red dye absorbs violet light and fades also; until, if the action is allowed to go on long enough, the green and the red colouration are entirely removed from the coating, and the tint of the paper

becomes that of the only dye which the violet light has not affected, namely violet itself. So that such a paper in violet light becomes violet. In the same way in green light it bleaches to green, and in red light to red. Exposed to mixtures of colours it bleaches proportionally. All that has then to be done is to apply some bath by which, when the bleaching has gone far enough, the colours remaining can be made permanent, and we have a process by which a sensitive paper can be made which under a colour transparency will give a picture in colours. This was the principle underlying "Uto" paper.

In writing of this paper, we have said that the colours are not very intense or very true; but we are very far from having any intention of depreciating the paper. When the difficulties of finding three dyes of the right colours, which can all be made to fade rapidly, and not only that but at practically the same rate, and which can have that fading checked or altogether prevented when the right stage has been reached, are realized, it seems so impossible a task that it is wonderful that so much has been done as has already been accomplished.

Colour-photography it will be seen has made rapid advances. Since the first edition of this book was published in 1906, everything referred to in this chapter of a later date than the Joly process has been introduced. It remains to be seen to what further advances these developments will lead. That they must have a powerful effect in some way or other is inevitable.

CHAPTER XX

DODGING AND "FAKING"

Selective focussing—Physical reduction—Baskett's reducer—The use of matt varnish —Work on the negative—Sensational effects—Printing in clouds—Work on enlarged negatives—The use of a guide print—A printing board—Spotting—Sunning down—Softening definition—Modifications when enlarging—Combination printing—Retouching—Vignetting by reduction—Guide prints—The misuse of dodging.

THE enthusiasm of the photographer who has managed to acquire sufficient mastery over negative making and printing to attempt to use them to make pictures, finds itself suddenly damped down by the limitations of the camera. That beautiful rolling moorland, broken by the play of light on the heather, and those immense masses of cumulus, are an uninterrupted grey patch in the print, uninteresting in itself and crowned by an even less interesting white expanse to represent the sky. The quaint old gables and chimneys of the Tudor mansion are delightful to the eye which can take them in and ignore the iron railing which divides the park from the lawns; but the uncompromising camera deals out impartial emphasis to Elizabethan walls and Victorian railing alike. The painter may show us a landscape with every plane subtly distinguished by the increasing veil of sunlit air through which we see it, but the photographer can only do likewise, by pure photography, when the photograph happens to be taken at a time when Nature has exaggerated her effect and so forced it upon the notice of the dry plate. For a little while in the career of most photographers, especially with those whose aims are to put their cameras to picture-making purposes, there is a feeling of disappointment, and sometimes almost of despair, when they begin to learn of the limitations of the process by practical experience.

There is no reason to despair. Far from it. The photographer who has learned to make good negatives, and good straightforward prints from them, has only mastered the A B C of his art. The hardest to learn, and the dullest lesson, no doubt, because everything beyond is brightened by the possibilities which unfold—possibilities no longer limited by the absolute literal truthfulness to outline, nor by the almost invariable untruthfulness to tone of the photograph. Both can be overcome, and the final result can be made as individual and personal as a painting or an etching.

Many photographers will ask why we should interfere with the product of the straightforward use of the camera at all, but the reply to such a question will be found in the chapter on pictorial work, and in the mind of the photographer himself. If he is content with what his camera gives him, let him stop at that, and look upon what we are now going to consider as not meant for him at all.

The first departure from the most purely mechanical employment of photography lies in what is termed differential or selective focussing. Half the changes which we want to bring about in our photographs are due to the uncompromising character of the purely photographic rendering, which gives important and unimportant details with equal impressiveness and force, and one of the methods by which this is remedied is by focussing sharply on the principal object in the picture, and letting the parts on which we wish to put less emphasis be blurred or indistinct. If it could always be done, it would be a most powerful weapon in the photographer's armoury; but, unfortunately, it is very rarely possible to use this as we would.

No local control whatever should be attempted during the development of the negative. So sweeping an assertion is not based on theoretical or dogmatic grounds, but simply on the facts that the development is done in an extremely poor light for seeing anything; it is done under circumstances which make it quite impossible for the photographer to gauge the extent and nature of the alterations he is effecting, and the changes he may bring about, good or bad, are irrevocable His aim, therefore, should be to produce a negative which, while not embodying any changes due to the photographer, is of such a character as to lend itself to after treatment. Such

a negative must be one which is not on any account overdeveloped, or there will be difficulty in dealing with it, because the easiest methods are by adding to its densities locally rather than by reducing them.

Chemical methods of intensification or reduction are only satisfactory when applied uniformly to the whole negative. If the plate has certain parts which may with advantage print a little lighter, it is sometimes possible to effect this easily by rubbing down. A little plug of cotton wool, or a fine handkerchief, may be stretched over the finger, and this being moistened with methylated spirit, and squeezed almost dry, will be found to rub away the image gradually. If too much spirit is used, the rubber will not bite; if too little, it will endanger the film. It is quite easy to determine the right degree of moisture, and to control the action. The rubbing should be done with as varied a motion as possible, to avoid lines or streaks, and as the rubber blackens with the silver removed from the negative it may be changed. The action is much quicker if, instead of rubbing with plain spirit, the Baskett reducer is used. This is made by mixing 2 ozs. of terebene, and 2 ozs. of salad oil with the contents of a twopenny tin of "Globe polish." The mixture is well stirred up and strained through two or three thicknesses of fine cambric, to remove any coarse particles, and will be found a wonderfully effective reducer. After reducing the film, the negative must be wiped as clean as possible, and given a rub over with a piece of cotton wool moistened with benzine to remove any remaining traces of the mixture.

But the most frequently used means of "dodging" or "faking" are additive, as they are not only more easily applied, but can be modified, removed, and reapplied as often as we like, without affecting the negative permanently in any way, which is a very great advantage. We may cover the glass side of the plate with matt varnish, which gives it a sort of ground-glass appearance. The varnish is applied by pouring a pool into the centre of the plate, tilting it so that it flows into each corner in succession, and then tipping the surplus varnish off, and standing up the negative to dry. If there are any parts of the negative which would be all the better for lightening a little, we can do this very simply by scratching off the varnish opposite to them with a knife. If the varnish

is plain matt varnish, this will make a distinct difference; but if a trace of a yellow dye has been added to it to tint it, the difference will be very much more marked. This may be done when it is necessary, but the plain varnish is to be preferred as far as possible, as it is more controllable.

The rough surface provided by the varnish will be found to take the pencil very readily. We can make lighter any shadows in the print which are too dark, by cross-hatching with a soft pencil on the varnish, or we can apply lead to it with a stump. In this way, and by removing the varnish in parts, great modifications can be introduced into the print which the negative will yield.

Another plan, which is perhaps preferable to the varnish, is to stretch *papier mineral* on the glass side of the negative. This is a very fine, textureless paper, which can be obtained from the better class of photographic dealers for a few pence per sheet. A piece is cut the size of the negative, immersed in clean water in a dish, and then placed for a moment between blotters to take off the surface moisture. With a small brush, or with one of the sponge-tipped gum-bottles now so common, a narrow edging of gum is given to the glass side of the negative, which is then laid down on the damp *papier mineral*, and picked up, bringing the paper with it. The edges may be gently pressed into contact, but there is no need to attempt to get the paper quite flat. If it is stood up for a few minutes it will dry, and on drying will be found to be stretched quite smooth and creaseless. With a sharp knife we can then cut away such parts of the paper as we wish, and we shall find that its removal makes a greater difference than the removal of colourless matt varnish. As it is not always possible to cut away what we want without interfering with the rest, we can get a similar effect by painting the paper, where we wish to make it more transparent, with a mixture of one part of Canada balsam and six parts of turpentine. We may also work on the paper with stump and pencil, or tint parts of it with water colour to make them print lighter. In using a pencil on the *papier mineral*, we must be careful not to be too violent, as the paper is very easily torn, and a tear may mean that all the labour we have put on it is wasted, and that we must clean off the paper and start afresh. Negatives that have been treated

with the paper must be stored very carefully also, or the paper will get injured.

Considerable modification can be carried out in this way. Such work is least likely to fail if it is used, not so much for the introduction of sensational effects, as for the concentration of the interest on some feature that is already in the negative. It is surprising how much can be done in this way to improve upon the plain photograph, without at the same time depriving it of its photographic character, or leaving in the final print any suggestion of the interference of the photographer with another method. By going over all the most distant parts with stump or crayon, they can be lightened in tone until they suggest their distance far more faithfully than is usually possible with the plain, undoctored photograph. Patches which are broken up too much with scattered lights and shadows can have the most intrusive lights toned down by the balsam treatment, and the deepest shadows strengthened with pencil touches, and in this way we can give that emphasis to the centre of interest which we desire.

The process is one which is easily abused, as our exhibitions are constantly showing. Pictures are to be seen in which the photographer has got a dull, flat negative, and by the insertion of high lights and deep shadows—where by no possibility they could be found with any natural illumination whatever—has obtained a theatrical and stagey effect, which may catch the untrained eye, and, to those who are not accustomed to study pictures, may seem for the moment very successful. But such pictures, as soon as the trick is seen through, cease to appeal to the spectator. They are the laughing-stock of the painter, and are only examples of what to avoid. We must remember that when we enter upon this ground, where painters have long been in possession, the knowledge which is indispensable to the painter is equally so to the photographer. The latter may not need the manual dexterity of the user of the brush, but he must at least have his feeling for the beautiful, his knowledge of composition, of values, of chiaroscuro, of those things, in fact, which every painter studies at the time he is acquiring his technique, but which it is safe to say no photographer thinks of when he is learning how to expose and develop.

The method of working upon a negative which has just been

A WIND SEA

BY F. J. MORTIMER

described entails printing in a very diffused light if the handwork is not to be apparent. In a strong light we shall reproduce in a print all the lines of which the cross-hatching is built up, and where the pencil and brush marks have a distinct edge this will be visible. By printing in a diffused light these edges and lines disappear, and the final result need not suggest the methods by which it has been attained. Negatives which have been treated in this way can only be used for contact printing, as when an attempt is made to enlarge from them the lens of the enlarging arrangement shows up the handwork. Other methods are therefore used when enlarged work is being done.

The modification that is most often carried out in contact printing is the printing in of clouds, an operation which calls for a good deal of skill if it is to be done properly. The landscape negative, it is very likely, is not dense enough in its sky portion for this to print out quite white. It may therefore be strengthened with matt varnish or paper and blacklead. If clouds are only to be slightly indicated, many workers can do this with a stump on the glass side of the negative. The method which some adopt, of making a silver print, cutting out the sky portion as accurately as possible with knife or scissors, allowing it to darken, and fastening it to the glass side to strengthen the sky, is one which generally results in the making of a harsh line on the print, however careful the worker. Blocking out the sky by painting on the film of the negative with Indian ink, or other opaque pigment, is equally objectionable. Such methods reveal themselves at once, by the different character of the definition along a line made with a brush and black paint, from that which has been given by the lens itself, and are all inferior in their results to the strengthening obtained by the use of a stump on paper or matt varnish. This can often be helped by shading with a black cloth during printing. The landscape portion of the silver print from which the sky mask was cut away may be used as a mask to protect the print while printing in the clouds; but, as a rule, it is easier to do this with a black cloth, as it minimizes the risk of a hard line showing on the print. All such combination printing, however, is crude, and in most cases unsatisfactory. It is preferable, whenever possible, to secure the clouds on

the same plate, which is easily done with an orthochromatic plate and a suitable screen. Such a method is a guarantee against false lighting, and such mistakes as have been seen at our exhibitions before now, when the landscape has very evidently been lit with the sun on one side and the clouds with it on the other.

The great opportunity for dodging a result comes when the original negative is to be made the basis of an enlarged one, because whereas by working with a pencil or stump, which is much the easiest way of modifying a negative, we can only cause it to print lighter in those parts to which we apply the blacklead, by working first on the transparency in the same way, we can darken portions which we wish to make darker, and then, working on the enlarged negative, we can lighten other parts by the same process. There is also a great advantage in working on a transparency that we are dealing with a positive and not a negative, and are therefore in a position to gauge the exact effect of every alteration we make. The transparency in such a case is best made the full size of the enlarged negative. It may then be covered with *papier mineral*, or tracing paper, or even tissue paper can be used; and work on this is done by applying lead or weak washes of Indian ink to those parts which are to be darker in the final print. Figures or objects which are not wanted can be got rid of with surprising ease in this process by using a little care. To do this we reduce any lights on the figures, as nearly as we can, to the same depth as the surrounding parts, ignoring those parts of the intruding object which are darker than their surroundings. Then, when the contact negative is made from this transparency, we can cover it with paper, and deal with the darker parts, which are now lighter than their surroundings, and are toned down accordingly. When this has been done we shall find that, without calling for any excessive degree of manual dexterity, the object which we wished to remove has vanished.

The two prints which face this page form an excellent example of the extent to which this treatment may be carried when there is any occasion for it. They are by Mr. C. J. Harrison, who writes of them as follows:—

"The original negative was not one of my own, but I am not sure that the offending branches might not have been

TWO PRINTS FROM THE SAME NEGATIVE

BY C. J. HARRISON

removed or avoided during exposure. However, they were not avoided, as the print shows, and it fell to my lot to make the best of this negative. The lower print shows how far I succeeded. Here all the dark branches that fell across the light brickwork were removed with pencil and brushwork on the film side of the negative, making no particular attempts to indicate the bricks, merely getting the retouched portions near the same density, and only trying to introduce the more striking marking, for a brick or so misplaced would hardly be likely to be noticed. The branches which cross the sky part were blocked out solid, as the sky was perfectly opaque. Then, as the finished prints were to be done on bromide paper, I did not trouble to rub down the light branches on the right, but touched them out of the print itself with Indian ink. Only a very close examination would show that these intervening branches had ever existed."

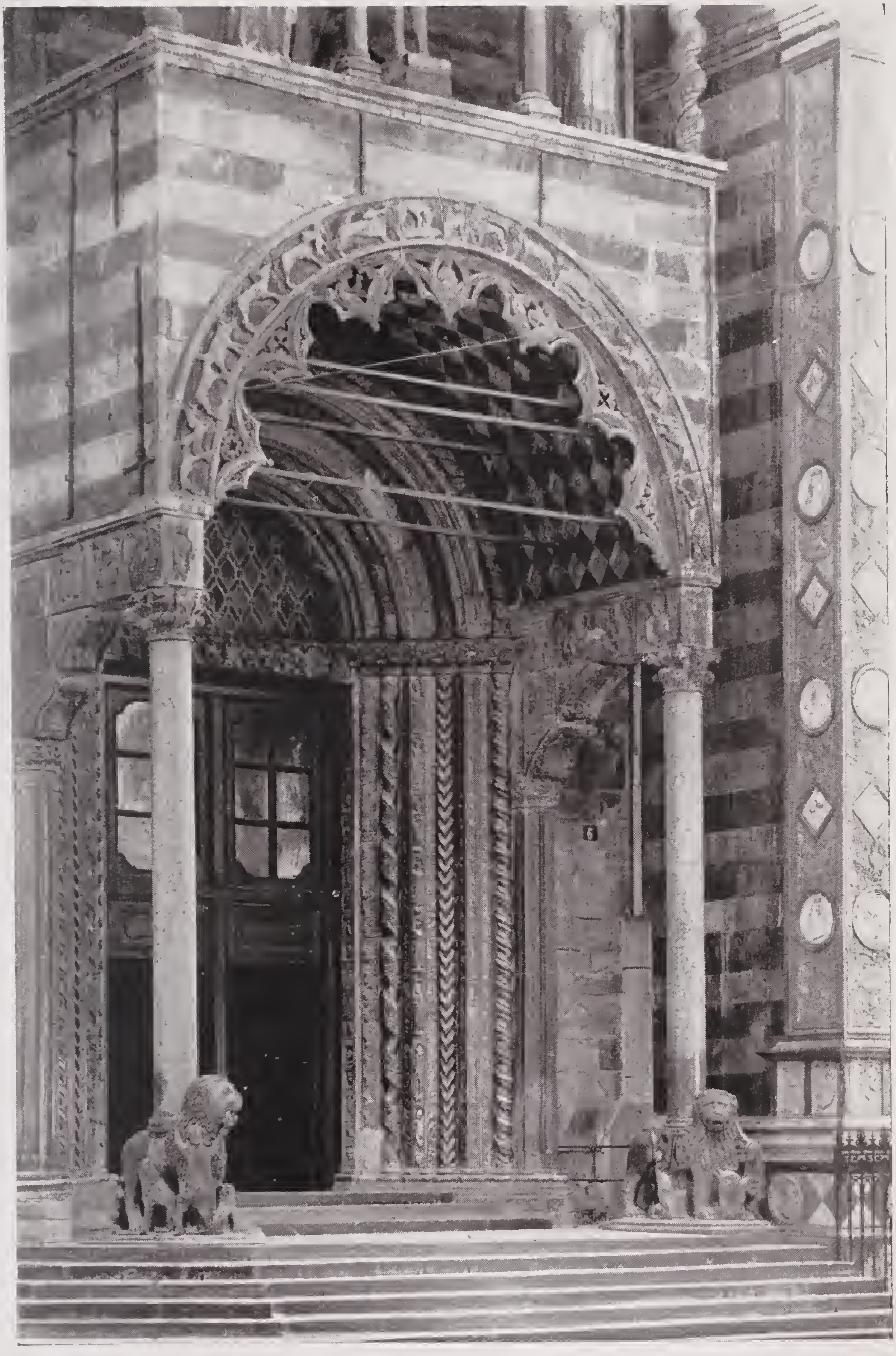
Whenever a transparency is to be worked up, it will be found a great help to take a plain print and sketch on this with crayon until approximately the effect desired is secured, and then to reproduce as far as possible the same effect on the transparency. Some workers employ a more rigid support for their handwork than paper. A sheet of matt celluloid may be used. Mr. Harrison uses thin transparent sheets of gelatine, and these, being cut to the size of the negative or transparency, may be attached to it with gummed paper, or even registered to it without.

For printing in large sizes for exhibition and similar purposes, we can dispense entirely with a printing-frame, and use a drawing-board instead. This allows us much more freedom. The paper, whatever it is, may be of a larger size than the negative, and fastened to the board with four drawing-pins. Then, if we arrange the negative in position on it, we can insert two pins along one long edge of the negative as far apart as convenient, and one pin in the centre of an edge at right angles to the first. Then, if the negative is always pushed up to these three points when printing, it should always be in exactly the same place. The writer uses fine needles for this purpose, which are pushed into the board with a small pair of pliers. In this way the negative can be removed and the entire print

looked at, and the negative replaced in exactly the same position, provided it is pushed up to all three needles. If the paper is fastened to the board in this way, it is quite possible that the weight of the negative itself will be sufficient to keep it in contact; but if not, a piece of plate glass may be laid on the top of it, or a drawing-pin or two used to keep it pressed down. If drawing-pins are employed, we must see that they do not pull the negative away from the guide-pins. If plate glass is used, these pins must be below the top surface of the negative, or the plate glass must be pushed up to them as well as the negative. These and other points will suggest themselves to the user of a drawing-board instead of a printing-frame.

When three needles or guide points are thus arranged, it is possible to make a series of masks or patterns, by working on ground-glass sheets, and to bring these up to register as often as required, so that a print can be continuously modified while it is being made. Thus we can print it a little, interpose a mask to prevent the sky, let us say, from printing, while the rest is carried deeper. We can then take the mask away and print the whole negative a little more, or inset a fresh mask. After each of such alterations we can take away negative and masks, certain of replacing them in exact register, and look at the entire print and see how we are progressing.

Amongst the minor devices, which may well be considered at this point, are spotting and sunning down. However careful a photographer may be, he will occasionally get negatives which have some slight defects, either in the form of transparent or of opaque spots. To prevent these from showing in the prints, the negative must be "spotted." This is done with a fine brush and a little opaque water colour. Indian ink does very well, but special colours are supplied for the purpose. It is a mistake to have the brush too fine; if it is a good one it will come to a point, which will allow very difficult work to be done, even if the brush itself is comparatively large. A very little of the paint should be used, the most important condition being that the brush is almost dry. Assuring ourselves of this by trial on a piece of white paper, each transparent spot is just touched with the tip of the brush, so as to make it print out white. When the print is made, a little colour is mixed up, so



PORCH, BERGAMO CATHEDRAL
BY ERNEST MARRIAGE

as to match its tone, and then this is used very dilute, and again with a brush that is almost dry, to touch out the spots. It is quite surprising to those who have never tried it before to find the ease with which the most disconcerting spots can be taken out. But the brush must always be in such a condition that it will only make five or six spots before it becomes too dry to mark the print at all. As a rule, it is not possible to get the colour dilute enough by rubbing the brush on the pigment; but a little being obtained in this way, a drop of water is put on a piece of paper, and the brush is worked up with that until it is seen just to tint the paper sufficiently for use.

Sunning down is a method not used as much as it might be. If we take a print just as it comes from the printing-frame, and expose it all over for a very short time to the light, we shall find, of course, that the highest lights will discolour more noticeably than the shadows, and that the result will be a print that is not so hard as it was before. If the sunning down is carried too far, the print will seem degraded and unpleasant; but there is no need to go as far as this. Moreover, if we will, we can localize the sunning down. A piece of tracing paper may be stretched on a sheet of glass, or a piece of ground glass may be used, if preferred; and putting this on the print in a light which has no effect on the sensitive paper, we can go over the outlines in pencil, and then apply blacklead or other medium to those parts which we do not wish to sun down, leaving the rest clear. The glass being held in position on the print, it is exposed to daylight until the necessary action has taken place. In spite of its name, sunning down is not a practice to be carried on in the sun, but in a diffused light, so that it may be well under control.

If the negative is one in which the definition is too keen throughout, there are various ways in which it can be softened. Very large negatives may be printed through the glass, or if the reversal which this brings about is objectionable, a thick piece of glass may be interposed between the film and the paper. A stout sheet of matt celluloid is more useful for this purpose, as the diffusion obtained with it is not so marked, but is often quite sufficient. A sheet or two of tracing cloth or of bolting silk may sometimes be used to advantage for a similar

purpose but the commonest method of getting rid of wiry definition is by the use of a rougher printing surface.

When enlarging direct on to bromide paper, there is not so much opportunity to modify the result as when enlarged negatives are to be printed by contact; but a great deal is possible, nevertheless. The use of a lantern for the purpose allows the photographer to intervene between the lens and the bromide paper. In this way, by the use of a card, he can shade parts of his subject, while letting the rest have further exposure. A sheet of glass, with a piece of card stuck in the middle of it, may be used if the part to be shielded is surrounded by parts which are to be exposed, or the card may be fastened to the end of a wire. Whatever screening is attempted, the screen should be kept moving all the time to avoid harsh lines.

Focussing when enlarging allows of a certain alteration being brought about, if the original is too hard; but "bolting cloth," or "bolting silk" as it is sometimes called, is still more convenient. This is a very fine fabric of regular texture, which can be obtained from the Kodak Company, to whom we owe its use in photography. It is best to stretch it on a piece of glass, or on a wooden frame, for use. If the bolting cloth is placed on the surface of the bromide paper during exposure, it will break up the image into little dots, almost like a half-tone picture, such as most of the illustrations in this book will be seen to be on close examination. Such an arrangement has its use in making the blackest parts of the enlargement less black, while the highest lights are hardly affected. It does not make much difference to the definition, but softens contrasts a little. But if the bolting cloth is slightly separated from the surface of the paper, it not only softens contrasts somewhat, but also softens the definition to an extent which depends upon its distance from the paper. Within certain limits, it may be said that the further off it is, the more blurry is the definition, until we reach a point where its effect begins to fall off again. If we move it still further away, it has no effect on the definition at all. Bolting cloth calls for a distinct increase in the exposure that must be given to the paper—generally from 25 to 50 per cent., but this depends on its distance from the paper. The easiest way of regulating the distance is to have a few pieces of glass of different thicknesses, and to interpose one or other

of these between the bolting cloth and the bromide paper. The latter must be perfectly flat upon the easel, or it will not be equidistant from the cloth all over, and the definition will vary accordingly.

There are other methods of bringing about alterations during enlarging, only one of which need be mentioned here. If we have a negative which will give an excellent enlargement in every respect but one, viz. that it is a little too harsh in its contrasts, it is often possible to soften it by giving nearly all the exposure necessary, and then holding a piece of card in front of the bromide paper. The front of the lens of the enlarger is then breathed on, and the disappearance of the moisture caused by the breath is watched on the card. When it has nearly (but not quite) gone, the last few seconds of the exposure are given, with the result that the enlargement is distinctly softer in its contrasts, without being blurred in definition.

Combination printing from two or more negatives is not difficult to any one who is able to apply to it the methods which are now being dealt with. It is easiest perhaps with the lantern, enlarging on bromide paper. To do this an enlargement is made from one of the negatives, shading with card those parts which are not required. The enlargement is then developed and washed, but not fixed: is blotted off with clean blotting paper until quite surface dry, and is then again put on the easel. The parts already developed are masked with black paper, any fine edges being protected by painting them over on the wet enlargement with photopake, and a second exposure is given. The photopake is then washed off, and the paper again developed. If the first exposure was correct, and the paper developed right out, the second development will have little or no effect upon it. Mr. Baskett has described a somewhat similar plan by which clouds can be printed in and other combination work carried out. The developed print is fastened on the easel with glycerine, and the clouds are developed up during the exposure by applying developer mixed with glycerine to those parts which need it.

Another form taken by combination printing is the preparation of an enlarged negative, which embodies parts of two

or more, and from which combination prints can be taken by straightforward printing. This is a method often used for the introduction of clouds into an enlarged negative. Having made an enlarged transparency of the landscape portion, the sky of which is practically clear glass, any light parts elsewhere on the transparency are painted over on the glass side with opaque water colour. Then, after focussing the cloud negative on the enlarging easel, the plate on which it is to be enlarged has the landscape transparency placed on it film to film, and, using the transparency as a mask, the exposure is made and the enlarged transparency of the cloud is developed. Landscape and cloud transparencies when finished are bound up carefully together in register, the glass side of each is cleaned, and a negative is made from them either with further enlargement or same size in the camera. Other combinations can be carried out in the same way.

Little has been said about the process known as "retouching," because it is hardly an amateur's method, since it is occasioned more from the desire of the sitter to obtain a smooth and flattering portrait than from any recognition of its photographic necessity by the photographer. It is certainly best left alone, at least so far as the form in which it is usually known is concerned; but there are times when a little handwork of such a kind will save a lot of after trouble with the prints. The first necessity is the application of something which shall give a tooth for the pencil. A special kind of varnish is sold for the purpose, known as retouching medium, A drop of this is applied by the finger to the part of the negative, on the gelatine side, which is to be retouched, and rubbed over until it feels "tacky," when it is put aside to dry. In the meantime some arrangement must be fixed up by which the negative can be supported at a convenient angle with the light behind it. A large printing-frame, with a piece of glass in it, will often serve, and on the glass may be put a piece of card to support the negative on its top edge. A good quality H pencil is the best to use, and this should be most carefully sharpened to a very long fine point. The tip should be an inch or more from the commencement of the taper. Fine emery paper is useful to give the last touch to the lead point. When the medium has become sufficiently dry,

VIGNETTE

BY H. WILD

we may place the negative on its support, and then proceed to work upon it.

The method of retouching must be left to the taste of the worker. The easiest plan the writer has always found is to make short, fine lines side by side. In fact, it resolves itself into delicate, but not "niggly" shading. There should be no attempt to get a lot of lead on in any one place by using a soft pencil or exerting any pressure, as this will result either in removing the medium or in breaking the point. Stippling a series of dots will often serve, while Mr. Harrison, who has been already quoted in this chapter, advocates working with a fine circular movement of the pencil, taking it off as little as possible, making a continual series of minute rings, keeping the pencil on the negative and always on the move, running lightly from one little defect to another, filling in thin places, blending all the harsh lights and darks, until the effect desired has been obtained. It is a good plan to start retouching by taking a negative of, say, some foliage which is a little inclined to appear spotty, and endeavouring, by the use of the pencil, to make the more transparent parts of the negative print lighter, so that the spottiness is less pronounced. Not only is it excellent practice, but such an application of retouching is more likely to be useful to the amateur photographer than is its employment in portraiture, which calls for other skill and knowledge than the mere ability to darken a light patch to the depth of its surroundings.

The vignette by Mr. H. Wild, which faces this page, has been obtained by a process which allows of the very easy removal of those parts of the picture which are not required, when that picture is on bromide or gaslight paper. Here also it is well to make a guide print first, and to try the effect of different alterations upon it with chalk, before actually setting to work on the final print. When the effect that is wanted has been obtained on the guide print, we may keep this before us while we modify the final picture. The method consists of the application of a reducer, which is made by mixing one part of a saturated solution of iodine in alcohol with two parts of a saturated solution of potassium cyanide (extremely poisonous) in water, and diluting this with water to suit the particular purpose in hand. "Some cotton-wool," says Mr. Wild, describing

his method, "a sheet of glass rather larger than any print to be treated, some small camel-hair brushes in quills (as cheap as they can be got, as they do not last long), and, if running water be available, a large dish of water in the sink—if not, two large dishes on the bench, with the water frequently changed will do—and three or four small saucers such as are used by architects for mixing water-colours, complete the equipment.

"In two of these saucers about three drops of iodine solution and six drops of cyanide are put. To one we add about half a drachm of water, and to the other about a drachm to a drachm and a half. The chalked print is pinned up where it can be seen, and, placing the dry print to be treated on the glass, a brush is dipped in the stronger solution, and all that is not required is roughly wiped out. It must not be taken out too closely, as at this stage a hard line will be left, which must subsequently be softened, so enough should be left to work upon. All parts that are to be taken out cleanly, such as chimneys on a house, boughs of a tree, or any other parts that are to be cleared away altogether, should be done at this stage, before the print is wetted.

"Having done this, the print should be rinsed well (for preference under the tap) at the same time lightly wiping the surface with a wad of wet cotton-wool. This should be left in one of the dishes of water just at hand, as it is wanted frequently, and sometimes in a great hurry. The wool is squeezed as dry as possible, and the surface moisture wiped off the print as it lies on the glass. We now proceed to soften and break up the hard edges, and to shade off where required. I find the best way to do this is as follows: the wool, full of water, is put on one corner of the glass, where it can be seized in a moment. A brush is dipped in the weaker solution, and wiped over the darker edges, and the solution so applied almost immediately wiped off with the wet wool. The wool is squeezed out, taking off surface moisture, and, if necessary, I go over it again, and continue this until I get the effect wanted. For the lighter parts it is advisable to weaken the solution still more. The weaker the solution the easier it is to get delicate gradations. When we have nearly finished, we shall probably find that some little dark bits, not noticeable before, will now look as if they

should be reduced in strength, or removed altogether. The print is rinsed, the surface wiped, and blotted with clean blotting paper. Then, with a small brush, or, for very small spots, a match sharpened to a point, we can take up a very little of the stronger solution and carefully paint over the parts to be treated. Only one bit is attempted at a time, and the wet wool is kept ready to wipe off with, while the effect is still a little darker than is wanted finally. A good washing completes the process, and it will be seen that the purely technical part is reasonably simple."

A method of obtaining very similar results on platinum prints by the use of glycerine was dealt with in Chapter XV. The guide print, upon the usefulness of which Mr. Wild lays stress, is even more valuable in this case, because of the fact that we are working from white to black, and not *vice versâ;* it is, therefore, very helpful to know exactly what it is we want to bring out in each part. There is no satisfactory method of reducing the platinum of the platinotype print in the same way that the iodine and cyanide solution will reduce a bromide print. Other reducers, moreover, are not applicable to a bromide print for the same purpose, because in removing the parts which are not wanted they give rise to a distinct change of colour on the vignetted edges.

In leaving the subject of "dodging" or "faking," let us add a word of caution about its misuse. There is nothing to which the purist can take exception in any of the processes employed to alter the strictly photographic result, provided always that the purist is not able to detect that they have been employed. If their use is apparent, then it is to be deprecated, not because it is not pure photography, whatever that may be, but because the art of the photographer has not been successful in concealing his art. Few indeed are the photographs that cannot be improved by judicious handling, but when that handling asserts itself as handling, it is no longer an improvement.

CHAPTER XXI

LANDSCAPE PHOTOGRAPHY

Pure landscape characteristically British—Size of camera—The lens—Films and plates—A view meter—Exposure meters—What not to take—The disappointment of panoramic views—Where to find subjects—Woodland scenes and tree studies—The fashion in subjects—Shipping and marine—Wave studies—The rendering of movement—The hilly road—Snow and frost pictures.

WHAT finer amusement can be desired by the lover of nature, with all the British fondness for fresh air and outdoor life, than to wander through the fields and woods, drinking in their charms of sight and sound and smell, with just that pretext for his stroll afforded by the camera. The fisherman claims that his sport brings him closer into contact with Nature than can be got by any other means whatever; but the landscape photographer may fairly challenge comparison with him. Whether he go abroad in the fresh summer morning, before the mists have cleared in the valleys and the flowers of the day have opened, or whether his shadow stretches far behind him as he turns to watch the glorious colouring of the setting sun, he is in touch with Nature, can note and study all her changing moods, and can endeavour to get, and may often succeed in getting, pictures which will recall to him, and perhaps to others, some of the delights he experienced in the making of them.

No class of subject, therefore, appeals to the amateur photographer in this country like landscape, and, to judge from the exhibitions, landscape without figures. This last is the result of the difficulty of introducing figures which shall seem spontaneous and natural—figures picturesquely clad, and at the same time free from any suggestion of the theatrical "countryman or milkmaid." The pure landscape—such as Mr. Job's "On the Arun," or Mrs. Dumas' "St. Martin's Summer," to

name only two examples—is the most characteristic product of British pictorial photography; and to obtain pictures of this type is the whole circuit and extent of the ambition of many a photographer.

The technicalities of the production of a good photograph of an outdoor subject are comparatively simple. Most of such work lies within the range of the user of a hand-camera, although, if he is wise, he will provide himself with a light tripod, as a support of some kind allows more careful selection and arrangement of nearly every subject, while under trees and in woods the exposure will often make it not a convenience but a necessity. "What should be the size of a camera for landscape work?" is not an unusual question. The reply has to be guarded. What weight of apparatus is the photographer willing to carry about the country? Two of the author's friends used to tramp the fields together, carrying respectively a 12 × 10 and a 15 × 12 outfit, each with one double slide, generally containing films or negative paper. With them might occasionally be seen just as great an enthusiast with a quarter-plate instrument and pockets full of dark slides. To judge from the photographers to be met with engaged in the work, half-plate is perhaps the most popular size of all, and one of the cheap stand-camera outfits, with a rapid rectilinear lens and a roller-blind shutter, will do all that is wanted in most cases.

The lens used on landscape work pure and simple is oftenest a rectilinear; but, as Captain Cuttle said on a memorable occasion, "Lord, it might be anything for the matter o' that." We should certainly not have had the modern triumphs of the optician had the needs of the landscape photographer alone been in view. No lens could be so bad as to be incapable of use in that work, and a pinhole, except for the length of exposure it entails, gives a quality of definition which many would like to be able to get with a lens. The single lens is often referred to as a "landscape" lens, because its one ineradicable defect—the curvature of lines, that are straight in the original, when they fall near the edge of the plate—is then immaterial; but the term is somewhat of a misnomer. A single lens is at least as suitable for portrait work, and, if of good quality and not used at too wide an angle, may also be

employed in architecture. On the other hand, any lens will do for landscape photography, and will do well, the principal thing of importance being its focal length. Too wide an angle is a defect, because the illumination in all wide-angle lenses falls off rapidly towards the edge of the plate, and therefore they are to be avoided when the subject does not demand them. In landscape it very seldom does. Moreover, the wide-angle lens tends to dwarf distance, and this in most landscapes is exactly the opposite of what the photographer wants. A convenient focus will probably be found to be about the length of the longest side of the plate, if the lens is a doublet. This will allow the back half of the lens to be used with most landscape cameras. In this way an image on about twice as large a scale as with the complete lens is obtained. If a single lens only is to be used, it may well be of longer focus than the doublet—say, half as much again. The caskets of spectacle and other lenses are very suitable, as with three or four lenses ten or a dozen combinations can be secured, giving a range of focus which will suit almost every imaginable requirement.

It is in outdoor photography especially that the advantages of films are so apparent. Their lightness allows more to be carried than could be done with plates, while they are unbreakable, and, greatest merit of all, are daylight loading. Until a few years ago it was a reproach against roll film that it was not orthochromatic, but that has now been removed. In very large sizes cut film takes the place of roll; or negative paper may be used with considerable saving in weight and little loss of efficiency. Even ordinary bromide paper has been used for negative making; but the coating of emulsion on it is purposely kept very thin, and therefore it does not have that long range which is such a characteristic of a plate or film made for negative work. Orthochromatic plates will be found to offer great advantage over ordinary, particularly if used with a screen. Indeed, in no work is their superiority so manifest as when they enable us to get clouds and landscape on the same plate, and when they differentiate between the light spring green of the new foliage and the deeper shades of the evergreen, which the ordinary plate renders practically alike and both far too dark. Backed plates are, of course, used invariably by all except those who are willing to sacrifice a certain

A DECORATIVE PANEL

BY DAVID BLOUNT

degree of quality to obtain a little diminution in trouble or expense. Very rapid plates are not so much a necessity in landscape work as in much other photography, but at times they are a boon. Particularly is this the case in windy weather, or when there is much light foliage in the foreground, stirred by the least breath of air. Those are the times when the shutter is most useful, not only for the short exposure obtainable in no other way, but for the liberty to watch the subject and to expose exactly at the right moment, without taking the eyes off it.

Those who use the hand-or-stand type of camera can carry it open and employ it as a view meter; but when the ordinary landscape pattern is adopted, particularly if it is half-plate size or larger, it is often inconvenient to carry it in any way except in its case. Instead of unpacking and setting it up every time there is any idea of taking a photograph, we can then add a simple form of view meter to our outfit, which will save a lot of trouble in this direction, by allowing us to settle upon the subject before the camera is taken out at all. The best form of meter is one which can be constructed at home in a very few minutes, out of a piece of card and thread. The card, which is best blackened, should have an opening cut in it the same shape as the plate, and with its two sides in the same proportion. By drawing the pencil round a plate put on a piece of paper, the proportion is easily obtained. We draw the diagonal of the plate very carefully on the paper, and then any rectangle we construct in the angle at one end of the diagonal will have its sides proportional to those of the plate, if its diagonal coincides with that of the plate. A convenient size of opening for a view meter to use with a half plate is one $3\frac{1}{4} \times 2\frac{3}{8}$, or with a whole plate $3\frac{1}{4} \times 2\frac{1}{4}$ inches. The width of margin all round the opening should be at least half an inch. The thread is fastened to the centre of one side of the card, and is marked at distances which bear the same proportion to the side of the opening as the focus of each lens available bears to the corresponding side of the plate. By holding up this card as far from the eye as is indicated by the mark on the thread, and closing the other eye, we shall see in the opening exactly the subject that we shall get on the plate, using the lens whose focus corresponds to the mark.

Where there are several lenses we can try the card at different distances from the eye, and in that way decide whether the subject is suitable or not, and, if so, what lens will be required. Such an instrument can be slipped into the pocket and saves a lot of packing up and unpacking.

The exposure meter is never of more service than in landscape photography, since there is so great a variety in the character of the subject and the strength of the light that reaches it. On the same afternoon we may have a cloud effect or distant view fully exposed with a hundredth of a second, a group of cattle requiring perhaps a tenth, a mass of undergrowth and moss-covered trunks with thick overhanging branches calling for two or three seconds, all with the same stop. Thanks to the orthochromatic plate and yellow screen it is now possible in many landscapes to secure the clouds on the same plate as the rest of the picture.

The earliest lesson the landscape photographer has to learn is that of what not to take. We have all suffered under the well-meaning friend who has guided us up to some place where there is "Such a lovely view; just the thing for your camera," and in common politeness we have enthused, and put up the tripod and made an exposure on it; but with what a result! The expanse of country which looked so fair and wide and luxurious as it spread out before us for miles, dotted with homesteads and woods, with the silver ribbon of the river winding through it, now bending round the hills we know, which from our present position hardly seem to rise above the general level, now flowing by the little church and beneath the old stone bridge, the whole panorama stretching out clear and unmistakable right up to the purple hills in the distance, is this the photograph of them? That white streak, can that be the river? And that dull grey patch cut off from the top of the print by a blank stretch of white. Do not say that that is photography's version of the delectable mountains and of the masses of cumulus that flecked and dappled them as the clouds floated by the sun. The church we find after much careful scrutiny; but the fields beside the river and the woods that crown the little hill are indistinguishable in tone from each other or from the houses. That is the camera version of the scene. The charm of colour we did not expect to get; but

the photographer who is making his first attempt at such a view may be forgiven if he expected a little more than this.

He forgot that his impression was not obtained by looking at some little bit of it through his view meter, but that he was conscious of the expanse around him, and that he turned his eyes from side to side, deriving a broad and general impression which the camera cannot render at all. The details stand out largely because of their colour, the blue haze through which the more distant objects are seen does not hide them from the eye to the extent that it cuts them off from the lens, and we are conscious of foreground objects with decided outlines and casting bold shadows, even if they are not included in our view for the moment. All these, of course, are absent in the photograph, which may just serve to remind us of the extent of the prospect, but can never convey a faithful impression of it to any one else.

The camera craves for some object near at hand with decided outlines, with bright lights and deep shadows, something on which the eye may fasten as the subject or dominant point in the picture; and this is just what is sure to be wanting in the panoramic view. The impression of space or extent is there to the eye, but it can only be conveyed in the photograph by having some object in the foreground beyond which the space is suggested. In plain language, there must be a mark from which the eye can measure, though the distance may be indicated by nothing more than the difference of tone.

For particular purposes views of wide expanses may be taken, but they are hardly to be regarded as examples of landscape photography in the ordinary acceptation of the term. It is often useful to have such a view, including a much wider angle than any ordinary lens would give, and for this purpose panoramic cameras have been devised, some forms giving the entire circuit round their standpoint. If one of these is not at hand, the ordinary camera may be used to take a succession of pictures, which are subsequently to be mounted up side by side. To do this the tripod top must be carefully levelled, and not moved afterwards until the whole series is complete, or the consecutive pictures will not follow on properly. In any case, it is better not to attempt to join them up in contact, but to mount them with a narrow space between each. The eye then

overlooks any slight lack of register, which otherwise would attract attention, to the exclusion of nearly everything else. The Panoram Kodak is a very popular instrument for views of this type, but even with it panoramas are sure to be disappointing, and it finds its best use when employed on subjects which demand a very wide angle, but subjects in which the interest lies essentially in the foreground.

In selecting a place in which to do landscape work, a photographer, if he wishes to do more than get a few pleasant mementoes of his visit—and most of us aim higher, whatever we reach—should be guided by his own liking for some particular type of scenery or some particular effect. One will find that wide stretches of flat country, broken only by dyke and hedgerow, and dotted here and there with church or windmill, seem to his eyes to offer more pictorial possibilities than woodland or hillside; and he will be wise if he tries to do his landscape work in the surroundings he finds so congenial. For years at the big London and other exhibitions pictures of this sort predominated to an extraordinary extent, and the flat country at the estuary of the Thames and the mouths of the Essex streams formed the happy hunting-ground of numberless photographers. Some went because they felt in sympathy with the subjects to be obtained there, but many were undoubtedly led to go in consequence of the work they had seen others do in that neighbourhood. For the typical English landscape of stream and pasture, quaint locks and timber bridges, that Constable loved to paint, many go to Constable's own country, making their headquarters at Dedham, near Colchester, a kind of photographic Mecca. It is a very delightful spot, though terribly hackneyed. The hills and valleys of Derbyshire, of North Yorkshire, and of the Wye and Severn district are more to the taste of some; while for peaceful river scenes, only failing, if at all, from being even too picturesque and sentimental, there is the luxurious Thames. All of which only comes to this—that the landscape photographer will work best in the country he knows best and loves most. Let him therefore be guided by his own inclinations, rather than allow himself to be tempted to pastures new just because he has seen fine work done there by some one else.

Woodland pictures pure and simple are the easiest, as far

as access to the raw material of which they are made is concerned; and for that very reason work in this direction is harder if it is to be fresh and original. The dweller in the country will know his own district well enough to find what he wants. The city man may need some direction, but should not want much. The Londoner is particularly fortunate in the beautiful commons and woods that lie only a few miles from the Metropolis along its southern edge, and in Epping Forest, stretching away for miles to the north-east. There is an immensity of material in the Forest for those who care to find it, though it is quite possible to walk far without seeing anything but brushwood and little unimportant shrubs. Some of the beechwoods there are magnificent, and there are silver birches, too, for those who admire that most graceful of trees.

The photographic possibilities of the silver birch were first forced upon the attention of photographers by the pictures of Mrs. Dumas, of W. Thomas, and of Charles Job (see the plates facing pp. 112 and 256), and when once these workers had shown the way, a host of others followed; and the Essex marshes were succeeded by a "birch-and-bracken" epoch. Later, we had years when ploughing seemed to have monopolized photographers' attention, and anon flocks of sheep, then landscapes seen through doorways, and the like. These are not given as hints for subjects, but rather as examples of the tendency there is towards a fashion or craze for some particular class of picture. It is best to leave such to those who care to make them; it is only one or two pictures by the pioneers that cling in the memory, and the host of imitations pass away and are forgotten. If silver birches, or sheep, or teams ploughing take the fancy, by all means use such material; but let the treatment be personal and individual, and the picture more than a mere echo of another.

Shipping and marine subjects generally, although not perhaps in the strictest sense landscapes, may well be treated here. No one has done more in wave pictures than Mr. Mortimer, and he has kindly allowed us to reproduce one (see the plate facing p. 336). This is a class of work altogether apart, and as practised by Mr. Mortimer in winter on the wild and stormy coast of the Scilly Isles, it is perhaps the most exciting and dangerous form of photographic picture making. A tripod is

of little use, the photographer must carry his camera, both in oilskins, and must use it much as it is employed in ordinary hand-camera work. "The ideal camera for wave photography," says Mr. Mortimer, "would be a box camera of the magazine type, absolutely waterproof, and with no projections whatever beyond, say, the shutter release, focussing screw, and view finder." The lens should be of fairly long focus, about 8-inch for 5 × 4, or 10-inch for half-plate, and a roller-blind shutter, working in front of the lens, with adjustable speeds up to one-hundredth of a second, and also a focal-plane shutter, would be required. The shutter must be in front of the lens, as otherwise there is nothing to protect the glass from the spray, which would cover it and prevent photography in a very few seconds. An exposure of an eightieth of a second with F/16, with a fairly rapid plate, will be found to be about correct for many wave studies. This is a type of subject wherein there is not merely the exposure required by the plate to be considered, but also the exposure necessitated by the movement of the subject. If the exposure is too long, the flying spray and swirling surf are blurred into indistinctness; while too short an exposure, such as that obtained with a focal-plane shutter working at its fastest, or almost its fastest, say one five-hundredth of a second, gives every detail so hard and sharp that the water seems lifeless or frozen, and all sensation of movement is lost.

The rendering of movement, the photography of objects in motion so that they shall appear in motion, has always been a difficult problem. With fast plates and a fast shutter it is not difficult, if the light is good, to get them so that they shall not show much sign of movement; but, then, that is not at all what is wanted. An express train, flying along at sixty miles an hour, might be photographed so that all its details were sharp and distinct, and the photographer might be very proud of the result. But pictorially there might be nothing to indicate that it was not standing still at the time. The painter gets the effect by showing the wheels as little more than a swirl; but no exposure that the photographer can give could show them anything like the painter's version. All he can do is to take care that the rapidly moving parts are not too crisply rendered, and help the effect as far as he can by the driving back of the

ZULEIKA

BY WILLIAM CROOKE

steam in the case of the train, by the cloud of dust from the motor-car, by the attitude or pose of figures riding or driving, and so on. It is one of the hardest pictorial problems to encounter in photography, and may well be put beside the photography of a hilly road. Let the photographer who knows a steep hill in his neighbourhood, if he is fond of grappling with difficulties, sally forth to get a photograph of that hill which shall in any way convey a suggestion of its steepness. The vertical lines of a house contrasting with it may seem an easy solution; but the house is not always there, and it is not possible always to show its lines so that they sharply contrast with the hill. Carefully posed or happily caught figures may help to give the right impression; but the almost impossible character of the task will surprise many who will think at first that, if it is a steep hill, it will look a steep hill in the print. It may appear as such to the photographer, because the print recalls the hill to him; but let him try the effect on some one who does not know it.

Snow and hoar-frost subjects are often very tempting, but their photography has difficulties of its own quite apart from those of cold feet and benumbed fingers. Hoar-frost generally resolves itself into the question of a suitable background to show up the delicate tracery of the rime-encrusted branches; but in snow scenes the trouble is to get snow that looks like snow. The texture of the snow surface cannot be represented by unsullied white paper; yet that is all that stands for it in many a snow picture. When we look at a snow-clad field, more especially when the sun is shining—but not then only—we cannot help being struck by the variation in what, without study, we might think was an even stretch of white, We see, plainly visible, a grain or texture over the white surface, and, besides this, a constantly varying tone due to the hummocks and depressions caused by the uneven ground beneath. Over and above this, we have the unevenness due to footprints, cart tracks, and the like, all of which may be valuable helps in picture making, and some at least of their appearance is essential if our snow is to suggest snow in any way. There are two means by which this end can be furthered: one is in the lighting, the other is development. If we stand in the middle of a snow-covered field and look around, we shall find

that in some directions the characteristic surface is much more clearly seen than in others, those directions being governed, of course, by the position of the sun, or the quarter from whence the strongest light falls. As the surface is not so easy to get at any time, we try and arrange our picture so that the lighting is secured that emphasizes it most. Then, again, in development, the snowy surface will probably be the highest light in the picture; but it must be kept thin enough for its detail to print out. Many a snow scene is spoilt from no other cause than over-development, with the idea of getting plenty of contrast, the result being that printing, if carried on long enough for the snow, has gone much too far for everything else. Those who are keen after pictures of this type will find a word of warning about the time of day may save disappointment after a snowfall. We can hardly start too early in the morning, provided it is daylight at all. The best effects are almost invariably to be secured at sunrise, or shortly after, and by eleven o'clock on a winter's morning much of its beauty may be vanished, the sun covered by the mist which precedes another fall, or else powerful enough to turn what was a glittering lace of hoar-frost into black and dripping branches.

There is no need, nor indeed is there space, to deal one by one with the many classes of subject into which landscape, or rather outdoor, photography might be divided. Each has difficulties of its own, each calls for particular treatment in some way, and each has its own charms and its own followers. It is the widest of all the divisions of photographic work, the most popular, and the most fascinating. Whether we take our cameras to the coast, where sea meets land in daily strife, or whether we wander by brook and meadow, where everything breathes of peace and quiet, we are in touch with Nature, led to study her in one or other of her many moods, and to take from her not merely pleasure and delight in the present and in anticipation, but that freshness and strength which the open-air life and the pure but absorbing mental occupation go hand-in-hand to give.

CHAPTER XXII

ARCHITECTURAL PHOTOGRAPHY

Cathedrals and churches—Interiors—The use of the exposure meter—Backed plates and halation—Perspective and point of view—Wide-angle lenses—The level—Most suitable type of camera—Anastigmats—Focussing dark interiors—Supplementary illumination—Living-rooms—Views through windows—Permissions to photograph—Their abuse.

THE photography of architecture may be approached either from the recording or the pictorial point of view; the object of the photographer in the one case being to obtain a delineation of some architectural feature or detail, and in the other to secure some passing phase or effect to convey to others the impression which the work makes upon him. This latter aspect of the subject hardly concerns us at present. The magnificent cathedrals and churches of this country are the inspiration of many a photographer, and few more delightful occupations for those who like camera work can be imagined than a summer day spent

> "Where spreading oaks embow'r a Gothic fane,"

following reverently the mind of its designers, and recording the details of shaft and capital, door and buttress, that take the fancy or lend themselves to delineation.

Moreover, for the effect secured the work is easy. The structure stands unmoved, and we can expose just so long as we choose. The lighting, as a rule, is bold and simple, and the difficulty of getting enough contrast in his plates is not likely to trouble even the beginner. It has difficulties of its own, but they are not great. The problem of exposure, approached in the way described in Chapter X., solves itself. The exposure meter in interior work is not to be held in the deepest shadow that can be found in the subject, but in some light which represents fairly the average illumination of the subject, the face of

the meter being turned towards the source of the light. As in this work the time taken for the paper to darken to the full tint is often very considerable, the quarter tint will be found to be sufficient guide ; this, in the Watkins meter, is the lighter of the two tints provided. Even then the time taken may be longer than the photographer cares to spend before commencing to expose. A very simple plan in such a case is to use such a stop that with the plate employed the time taken for the quarter tint to be reached is the correct time of exposure, and then to start exposing both the plate and actinometer paper together. When the latter has darkened to the tint, the lens is capped. If a smaller stop than the one so indicated is necessary, it is easy to prolong the exposure accordingly ; but this hardly ever happens. With an ordinary (not extra rapid) plate, the Watkins quarter-tint is generally the exposure required with F/32.

Outdoor work on architectural subjects calls for no special notice.

If there be one purpose for which backed plates are more than ever necessary, it is in interiors. The range of light is so great, and the strongest illumination is often so close to the deepest shadow that, without proper backing, halation is almost sure to be troublesome. Round a brightly lit window, even with a backed plate properly exposed, there will often be noticed signs of halation. It is a mistake to regard these as a defect ; as if such a subject is looked at critically, it will at once be apparent that the effect can be seen with the eye also. In fact, round any very brilliantly lit object there is always a certain glare, and if the true effect is to be secured in the photograph, that glare must be shown.

Without trenching on the subject of pictorial photography, a few hints on the arrangement of architectural subjects may not be amiss. The direct square front view of a building is nearly always unpleasing. The effect given is too much that of a geometrical design or elevation, and an improvement is at once manifested when the building is regarded more at an angle. At the same time, this must not be overdone, for the camera placed opposite one corner—the line from it to the corner exactly bisecting the angle of the corner itself—gives a result even worse than the "straight-on" view. The actual

THE ONION FIELD

BY GEORGE DAVISON

angle must be decided by circumstances; but it does not need a very great departure from a front view to obtain the best effect, as a rule. In the same way, the camera should not be set up in the centre of an aisle or colonnade, but a little to one side or the other. In this case it may point straight down the aisle, taking care that the more interesting side is that which is the more fully shown. In subjects such as this we have to be careful to make the picture complete. That is to say, important architectural features must not be shown in a truncated form: a heavy arch should not have its supporting pier or column removed: nor should a prominent column be shown without its base. If the arch must be included, its contour should leave the picture while it still tends upwards, so as to avoid any feeling of want of support or instability. It is as bad, or even worse, to get the principal feature just on the plate, so that the first feeling aroused on sight of the print is what a close thing it was that it was got on the plate at all.

Another point worth mentioning is the avoidance of an unusual standpoint. The architect built for his work to be seen from the height of the eye, say 5 feet from the ground, or thereabouts; and, as far as we can, if we are to avoid an unnatural appearance in the print, the camera should view it from a similar position. It is often much more convenient to take advantage of some elevated standpoint to get the view we want, but the view suffers. Nothing gives a more unsatisfactory rendering of some architectural feature than the appearance in the print of the upper surfaces of details and mouldings that were manifestly intended to be seen from below. Such a standpoint also leads directly to a very common failing in architectural work, and that is the inclusion of insufficient foreground. This may arise also from the use of the rising front too heedlessly. The sense of space in front of the work that is being photographed is lost when the vertical lines of the building are only allowed to meet the ground close to the bottom of the picture.

These are only general considerations, and must be modified according to circumstances; those circumstances nearly always resolve themselves into insufficient room to get the camera far enough away from the subject to allow of the use of anything but a wide-angle lens. The wide-angle lens in

architectural interiors comes in for a lot of abuse; but it is open to question if it is not better to employ it constantly, even when there is just room for one of longer focus to be used. If this course is followed, and the photographer is able to screw his courage up to the sticking-point and trim his prints down ruthlessly, he is less likely to find, when he comes to consider his finished print, that he has cut things too fine, and that in order to be able to use his long-focus lens he has just sacrificed a bit of foreground which is almost a pictorial necessity. If the wide-angle lens is always used as suggested, it must not be made a pretext for getting close up to the subject, as then the perspective will seem forced. It will give us pictures on a smaller scale than the long-focus lens, and that we must put up with, or enlarge, but the power it gives of making the final selection of the subject to be included on the finished print instead of on the focussing screen is a very valuable one.

The level is a necessity in architectural work, and the photographer who does not want to have distortion caused by tipping the camera will be wise if he provides himself with something more than one of the little patterns made for attaching to the camera. The best of all is a metal square, with a spirit-level let into one side; many of the tool shops keep it. One side is placed on the ground glass itself, and the level will at once indicate any departure from the vertical. Failing this, a plumb line, such as can be extemporized from a piece of thread and a bunch of keys, will be found the most convenient.

If much architectural work is to be done, that fact ought to be borne in mind when the camera is being bought. Some workers have expressed a preference for a camera with taper bellows, the back fixed and the front racking out; but a better form is the rather old-fashioned square type, focussing from the back as well as from the front. Ample swing on the back should be provided, especially if telephotographic lenses are to be used on distant details, and in that case a strong firm tilting table is almost a necessity. A more important feature in the camera used for architecture is the rising front. A very common defect is insufficient rise; nothing limits the photographer so much. It should be possible to raise the lens until its top edge is in a line with the top of the plate; more than this may at times be useful. An arrangement for holding the

tripod legs to prevent them slipping on stone floors is also a very comforting one, taking a lot of strain off the temper, and sometimes preventing serious damage. When it is not to be had, corks may be fastened on the points of the tripod, or pieces of rubber tube slipped on, or a focussing cloth may be put down to prevent any sliding about. This last device may be employed in English churches, but in Continental cathedrals is too expensive, as, if the photographer is at all squeamish, he may want to burn the cloth after use.

Most that need be said about the lens and its use has already been given, and there is little to add. The best of modern anastigmats is not too good for the purpose, for if ever there is a subject which can take advantage of all its excellences, it is an architectural one, and an interior at that. If only one lens is to be carried, it should be one of decidedly wide angle, since this can be used on all subjects, and when possible the print may be trimmed down, or a portion of the negative enlarged. If this is not the case, and a lens of normal angle is used, the photographer will find that a certain number of subjects which he would be glad to get will have to be omitted. Such a lens as is suggested would be a 4-inch lens on a quarter-plate, 6-inch on half-plate, 8-inch on whole plate. If a second lens is possible, one of a focus half as long again will be useful. The advantage of many of the modern lenses is, that while nominally very rapid medium angle instruments, they are also good wide-angle lenses when used on a larger size of plate. Thus a quarter-plate anastigmat of 5-inch focus in the author's possession, which can be worked at F/6·3, may be used with excellent results on a half-plate by stopping it down to F/22, while its back combination, of a little over 9 inches focus, covers a half-plate at full aperture, in that case F/12·5. There is an impression in many quarters that a single lens, however good, is not suitable for architectural work, on account of its distortion of straight lines. This is largely a question of the lens; with some the distortion is very marked, with others it will hardly be detected, unless a subject is specially arranged to give it, by getting a long straight line close to the margin of the picture, so that the slightest discrepancy between the two can be seen.

Focussing in interior work is sometimes very difficult, on

account of the difficulty of seeing the image. Many get over the focussing difficulty by doing the best they can by their unaided eyesight, and then using a stop so small that everything must be sharp. There are certain lenses which must be focussed with the stop that is to be employed, the stopping down altering their focus, and therefore tending to blur things that were sharp originally; but the real objection to this rather happy-go-lucky sort of treatment is that it makes exposure so much longer than it need be—and exposures in interior work are generally quite long enough as it is. In very many cases where there may be trouble the difficulty is simplified by the fact that the most distant object is a window or other high light, that can easily be seen on the ground glass. In that case we can focus the window as sharply as possible, insert the largest stop likely to be serviceable, and then gradually rack the lens and plate further and further apart, stopping as soon as any departure from absolute sharpness is noticeable in the outline of the window. If the foreground objects cannot be seen on the screen, a candle may be lit and placed against the nearest of them, and it will soon be seen if it is sharp or not. If not, then a smaller stop is inserted, the distant high light is again focussed, and the procedure repeated. Even when there is not a window in the field of view, and the most distant object is dark, it is often possible to employ this method by turning the camera so as to bring one of the windows into the required position, focussing on it, and then turning the camera back. In all such cases we should remember that a little diffusion, which would be quite allowable or even unnoticed in a distant object, would spoil the picture altogether if it were noticeable in the foreground. A couple of short pieces of candle should always be included in the camera-case when interiors are likely to form the subject of the work. Very often they can be placed on the nearest and most distant parts respectively, and then the task is a very easy one. When both of these are inaccessible, and the image cannot clearly be seen on the screen, at the worst we can place a candle at a position behind the nearest object, distant from it approximately one-third of the separation between that nearest point and the most distant one. Focussing then on the candle, and inserting the smallest stop permissible, we can be confident that we have got a fairly good

general focus. Such devices, fortunately, are very seldom needed

Professional photographers, who have much work to do in dark interiors, often manage to reduce very much the time needed to get a full exposure by using magnesium to help in the illumination of the deepest shadows. It is a very dangerous auxiliary for those whose work is to be seen and judged by other photographers, but in prints for the non-photographic public, whence the professional draws his customers, false lighting or a few extra and unexplained sources of illumination make little or no difference. They merely want to see everything that they know to be there; and, to do the professional justice, he generally gives them what they want. If magnesium is to be used at all, it should be used very sparingly. Ribbon is more convenient than flash powder, as it is more under control, and, burning slower, may be moved about more. It is out of the question in most sacred buildings, and in others which are of national importance, but in domestic interiors it may serve its turn. It is, of course, kept well out of the field of view, the necessity for that any one can see; but when it is used in an ordinary room, with mirrors, pictures, brightly polished furniture, and similar things about, the difficulty of avoiding a reflection of the light is much greater than many would imagine. The only way to make quite certain is to have a piece of the ribbon burnt in all the positions it is to occupy, and to watch the screen closely all the time. If the blinds can be drawn down while this is being done, so much the better.

There is an effect which many a photographer tries to secure, only to find that he fails: an interior of a room with, at the same time, a view through the window. If there are two windows to the room, we can darken one by hanging brown paper all over it, and giving nine-tenths or thereabouts of the total exposure by the light of the other, the window that does not figure in the field of view. Capping the lens while the brown paper is removed, the remaining tenth is given when the window is uncovered. The actual relative exposures must be ascertained by trial. If the first is too long, the room will look unnaturally light. As a general rule, it is well for any error made to be on the dark side, as far as the room itself is concerned. By giving the two exposures on two separate plates

and combination printing, a better effect can often be obtained, but it requires more skill, and is considerably more troublesome. Occasionally the effect sought for can be got by working on the negative with cotton-wool and a little Baskett's reducer (*q.v.*).

While, in buildings of any architectural pretension, the photographer, as a rule, has the advantage that the subject of his work has been arranged and lit on purpose to show it to the best effect, this is not invariably the case by any means; and the question of illumination will often be a puzzling one. The morning and evening, when the sun is low, are the best times for the greater number of subjects, and in this country at least there are many interiors in which photography is only possible during the summer months. Spring weather—sunshine and fleeting clouds—while reducing exposures, may give trouble from the necessity of waiting to secure some given effect of sunshine and shade, or to avoid it. There are many comparatively commonplace subjects which are transfigured by a shaft of sunlight; and this is nothing like so difficult to secure as many might think. Perhaps as fine an example of this as has been done by photography is seen in "Wirksworth Church," by Mr. Bland (the reproduction faces this page). The value of the sunlight streaming in by the chancel windows speaks for itself. A totally different lighting proved very useful to the author some years ago, and may be mentioned as one of those unusual accidents which are beneficial rather than otherwise. He had tried to photograph a fine old oak ceiling, black with age and very badly lit, and had got a result with which he had to be satisfied, as, poor though it was, it seemed the best under the circumstances. The merest chance took him there one spring morning after a light snowfall, and the illumination, due to the light reflected from the snow, was so much improved that, at considerable inconvenience, the roof was photographed again. The result was one which could never have been obtained but for the snow, and puzzled considerably a number of photographers who had tried their hands on the same subject. The moral to be drawn is that difficult work of this kind should be seen under as widely different conditions as possible, and the best selected. Of course, the lighting of an interior due to snow outside is hardly likely to give a true effect, unless the presence of the snow is suggested in some way; but in this case

WIRKSWORTH CHURCH

BY W. R. BLAND

it was a simple question of getting a good record photograph of the fine carving.

It is not easy to get a photograph of an ordinary living-room which will look quite natural. Some suggest that all the furniture has been pushed up into one corner for the operation, while others look as if they had been arranged to death. Exclusion should be the guiding principle of any arranging that has to be done, taking away first one thing and then another, until a satisfactory effect is obtained. Pictures are often the source of brilliant reflections where they are not wanted, and these ought to be looked for specially, as otherwise they may only be noticed when the print is made and alteration is impossible; a cork or wedge behind the frame will often alter its angle sufficiently to prevent an unpleasant reflection from the glass. Furniture close to the camera, so that only part of it appears, and that disproportionately large, should always be removed, and as much space as possible allowed between the lens and the nearest object. This is generally the chief trouble in photography at home, because of the size of the room. In such a case the photographer who finds a door behind his camera, so that he may get a few feet further back, is lucky; those few feet often make all the difference.

Permission to photograph in cathedrals is generally obtained by written application to the dean. The actual permit often comes from the chapter clerk or surveyor. At some of the cathedrals a charge is made, notably at Norwich and Canterbury. At Peterborough no permit at all is required. At others, members of photographic societies that are affiliated to the Royal Photographic Society are permitted to photograph without special permission, on the production of the "Red Book," which acts as the certificate of membership. It ought not to be necessary to point out that religious buildings of all kinds are erected for other purposes than photography, that it is a concession on the part of those to whom they belong, or in whose charge they are, to allow photography to be carried on within them, and that the character of the building should always be remembered. With public and private buildings alike, it should not be forgotten that the fact that the conditions under which photography is allowed are published does

not confer a right on the photographer; and that in availing himself of the permission granted, he should leave nothing undone to prevent the necessity for making them more stringent. A case came before the writer not very long ago, when he found that a building of great beauty and historic interest was closed to photography without special permission, whereas at one time there were no restrictions. The cause on inquiry was found to be that a photographer with more enthusiasm than *savoir faire*, without any inquiry or warning, had blazed off a quantity of flash powder in one of the rooms, filling it with smoke, and setting some of the woodwork on fire.

THE DEWDROP IN THE SUNBEAM

BY MISS KATE SMITH

CHAPTER XXIII

PORTRAITURE

The necessaries—Neither studio nor "portrait lens" essential—Diffusion of focus—Type of camera—Backgrounds—Niagara Falls as a background—Portraits in ordinary rooms—Position of the sitter—Reducing exposures—Sunshine effects—Under-exposure and over-development—Dress—Outdoor portraits—Groups—The hands—Artificial light—Magnesium—"Smokeless" powders—Retouching—Animal photography.

IN portraiture we have at once the easiest and the most difficult of all the applications of the camera. It is the easiest in its technical details, because, as far as these are concerned, the conditions vary so little for different portraits. The illumination is far less variable than it is with landscapes or with architecture, for instance, and it is very much more under control. There is no such immense range of light and shade that the plate has its capacity taxed to the utmost, or even exceeded, in the attempt to register it truthfully. The subject is set us; and, in its simplest form, the problem how to get a passable negative is easy in the extreme. It is only when our ambition carries us to attempt higher flights that we begin to realize the difficulties of portrait work. When we are no longer satisfied with a mere bald record of the sitter's exterior; when we want to get a picture which shall not represent him merely as he happened to look when being photographed, but as we know him to be; when we are no longer content that he shall be shown as a head together with some clothes, arms, and legs, but that the arms and legs, and even the clothes themselves, shall form part of one complete representation, and help to show us the man as he is—not suggesting even that he is being photographed, but simply suggesting *him*.

The noblest study of mankind is man, says the poet; and later commentators have added that man embraces woman. In

photographic portraiture we have the noblest side of photography, or at least we might hope to make it so. Before attempting any of such higher flights, however, we have got to master the rudiments of the art; we must learn to walk before we try to fly.

Let not the reader be deterred from attempting portraiture because he does not happen to have a regular studio, or even a portrait lens. For professional photography, for dealing with children, and with nervous sitters who have heard of "the instantaneous process" and insist on that latest product of science being placed at their disposal, such means of cutting down the exposure to the minimum are very useful. But, except for the shortness of exposure they allow, there is nothing to be gained from the use of portrait lenses; while, as far as studios are concerned, they will give certain lighting effects not easily secured in ordinary rooms, and will allow us to control the lighting readily, but are not otherwise of much service. Certain it is that ordinary living-rooms, if only they are large enough to allow the camera to be placed far enough from the sitter, give a wonderful choice of lighting suitable for different subjects, and give a certain guarantee against unusual lighting, which is the besetting sin of the studio worker. Nor is the light in the ordinary room necessarily so weak as to make exposures difficult; and under favourable conditions from five to ten seconds should do all we want.

The "portrait lens," so called, was the result of the demand for the shortest possible exposure, when exposures ran to minutes rather than seconds, and much in its design was sacrificed to rapidity. It is still used and popular, and for the purpose of professional work is a valuable help. Its size and weight and cost render it rather a white elephant to amateurs. Only a solidly built studio camera will hold a whole-plate portrait lens, while many a landscape-pattern camera has not a front large enough to take it, even were its build strong enough to carry such a burden. The most serviceable lens the amateur can have is his anastigmat, rapid rectilinear, or similar all-round tool, for full-length figures; while for large heads, busts, and work on a comparatively large scale, the single half of that instrument, or, better still, a single lens of longer focus, will be found useful.

There is one advantage about some forms of portrait lenses that is not to be despised, and it is due to a feature introduced many years ago by the late J. H. Dallmeyer. By unscrewing the cell which holds the back lens a little way, a certain degree of blur or diffusion of focus can be introduced at the will of the photographer. It may be asked, Why is there need for such a device, when the image may simply be thrown out of focus? But the result is not at all the same. When we throw the subject out of focus, the extent of the blur varies according to the position of each part with reference to the camera. When we get the desired blur on the principal object, we may find that a more distant part is so terribly diffused as to be offensive and a nearer part has been brought into critically sharp focus, and is in consequence altogether too prominent. Or this state of things may be reversed, the nearer object being blurred and the distant one sharpened. In either case the result is not what we want, and we shall find, sometimes at least, that by mere focussing with a lens that can give a critically sharp picture, the effect is not to be got. The adjustment on the Dallmeyer and other portrait lenses is of a different nature entirely. It introduces a certain degree of diffusion over the whole picture, over and above any due to selective focussing; and it also gives us the very valuable power of increasing or decreasing the diffusion at will, or of repeating any particular effect exactly. To accomplish this, all we have to do is to take care that the extent to which the lens is unscrewed is the same each time. When large portraits are attempted, and softness of focus is very desirable, the Dallmeyer-Bergheim lens, already referred to, will be found very useful, both for the extent of the diffusion that is possible with it, and for the fact that, being constructed on the telephotographic principle, it can be used at a considerable distance from the sitter without any need for an abnormal camera extension. But portrait lenses of these types are costly, and partake of the nature of luxuries rather than necessities; and a single lens, even an uncorrected single lens, in the hands of one who takes the trouble to master its capabilities, will do wonders. For large work critical definition is rarely wanted at all; the perfect lens sharply focussed gives quite an unnaturally sharp texture to skin and hair and fabric. In such cases the single lens may be opened out to work at

F/11, or even at F/8 or F/6, and will do wonders at that. Those who like a compromise between a portrait lens and a rectilinear, and propose to limit their work to half or whole plate, will find that kind of lens which goes under the name of the Euryscope very suitable, being faster than the rapid rectilinear (F/6 usually), and if slower than the portrait lens, at least flatter in the field. Pinhole portraiture has been performed—performed is emphatically the right word under the circumstances—but is hardly practicable, or rather is practicable hardly.

If no special form of lens is a necessity, still less is any particular type of camera. The landscape camera, if it will carry the lens, will do all we can want of it; but portrait work with a tripod, if possible, is at least very inconvenient. Far more handy is a simple studio stand, on casters or otherwise, by which the camera can be raised or lowered without moving the feet, and the whole arrangement moved to and fro as desired without having to adjust three legs every time. It need not be an expensive one, provided it will stand firm and has the needful adjustment. A studio shutter, opening inside the camera so as not to be noticeable, and provided with an ample length of rubber tube and a big bulb, is a luxury, but again, is certainly not a necessity; it may prove a nuisance in long exposure, unless kept in very good order, by a trick it will sometimes acquire of gently closing while the bulb is still tightly pressed.

The most obvious necessity of the portrait worker will seem to be a background of some kind; yet even with that he may dispense, and, if he can, his work will be the better for it. Except in large heads, and very few other instances, the complete elimination of surroundings is a mistake. It is generally due to a desire to dodge the difficulties involved in dealing with accessories. The studio background, with its trees, landscape, rustic bridge, or whatever it may happen to be, it is to be hoped, will never find its way into the workroom of the amateur. Such a self-proclaimed sham has only to be seen to be condemned. The background is merely the setting of the figure, and therefore it should either be a natural background of the actual surroundings in which we see him in life—carefully selected, arranged, and lit, it is true, in order to help

HARVEST MOUSE

BY DOUGLAS ENGLISH

towards that effect which it is our object to secure—or else a mere tint which may show up the model without attracting attention to itself, either by what it purports to be, or by what it is not. It comes, then, to this—that our background should be a perfectly plain fabric of suitable tone for our purpose, or that we should use the ordinary surroundings in the room. In other words, the best background of all is none at all.

As it is often impossible to arrange the surroundings in the way desired, or as the portrait may be merely a half or quarter length figure, or perchance the head alone, when any distinct character in the background would be competing for attention with the sitter and out of place, something in the nature of a plain background is at times very useful. This may be extemporized, or made, or bought. A background which did very good service with a clever portrait worker of our acquaintance was a buff-coloured camel-hair travelling-rug, which had one feature we have never seen possessed by any other background whatsoever—it could be rolled or folded or crumpled to any extent and apparently for any length of time; but when pinned up by two corners it hung flat and smooth, without a crease or wrinkle to cast a shadow. Rollable backgrounds with their two sides of different shades are purchasable; but they must be handled very carefully if they are to be kept free from creases. The most lasting background is one made by stretching sheeting on a frame, and giving it two or three coats of colour, which may be distemper—whitening, size, water, and colouring matter—or flatted oil. The latter lasts longer, but the former is so easily renewed that it is generally to be preferred. Flatted oil is the term applied to oil paint which has had the shiny character of its surface destroyed by being treated with a mixture of the colour and turpentine only, the brushmarks being taken out by stippling the surface, before it dries, with a badger softener. Those who do not care to adopt this can employ a makeshift almost as effective, but not so lasting, by applying the colour, in fine powder mixed up with powdered dextrine, to the material which has been damped to receive it. Brown or grey paper sold in rolls about 5 feet wide, under the name of carpet felt, makes an excellent background, which, if not lasting, is at least

very easily renewed. Other materials will suggest themselves from time to time.

It is important that a background, when one is used, shall not assert itself as such. It should either appear as a mere tone in the print, or else as the surface of the wall behind the sitter. Creases and folds in walls are not customary, and we must therefore avoid them in the background which is to represent the wall. If the creases are slight they may be made invisible by throwing the background out of focus, while even bad ones can be hidden if the background can be kept moving during exposure. The fault of the elaborately painted background is not that it represents itself to be what it is not, but rather, that it does not represent itself as what it purports to be. The dull, uniform tint of a flat background may well stand for a wall, as no one can say that it is not, and the effect in every respect is what it would be were it a wall. And in photography the effect is what we strive after. On the other hand, no one with the slightest power of observation or art training can be taken in by the representation of a figure, with most unmistakable indoor illumination on it, standing in front of a painted landscape. At Niagara they will take you standing in front of a background representing the falls, but the effect is only fit for those who appreciate it. That there should be a public for such things—and there is one, and a large one, on both sides of the Atlantic—must excite the astonishment of all except the cynical.

In the use of a background its position with regard both to the model and the light is very important. If it is close up to the sitter, or very near him, he will throw a shadow upon it, which is often very useful pictorially; he may even be in contact with it, and so his pose will get that support which such contact will inevitably suggest. But it must then be a pose with which such support harmonizes. No one sits in an ordinary everyday position touching a wall, or even very near it, but in the smallest room naturally selects a place where there is a certain space for freedom of movement; therefore, if such a pose is adopted, the background must appear to be well away from the figure—an illusion which can be at once destroyed by the appearance on it of the sitter's shadow. The darkest background will show a shadow if it is in a fairly

DR. MUNRO (1846)

BY DAVID OCTAVIUS HILL

strong light. The angle it makes with the light is important, because of the means it gives us of controlling the tone of the background. The more it faces the light the lighter will it appear, because it will receive more light than when it stands obliquely with reference to the source of light. This is mentioned here, because it has been stated recently by a writer on portraiture that the reverse is the case; an observation which shows that its author is more familiar with an elementary law concerning the reflection from polished surfaces, than he is by experience with the behaviour of the dull matt surface of a background reflecting diffused light from a limited source.

The principal faults of the ordinary room for portraiture are that it entails a longer exposure than would otherwise be needed, and is often inconveniently small. On the other hand, there is less temptation to produce a portrait of the "being photographed" type, beyond which so few professional photographers seem able to get. We can show our sitter as we see him, amid his everyday surroundings, and in an everyday pose. It is this that we must study to secure, and when the camera is set up and the general arrangement has been settled, a very important part of the task remains. As far as the material before the camera is concerned, all unnecessary objects likely by the contrasts they present to be assertive where assertion is not wanted, must be removed or rearranged. It is not the objects themselves that will give trouble, so much as the way in which they become prominent by contrast with their neighbourhood. So long as the general effect is low in tone, where lowness in tone is wanted, the mere presence of a lot of accessories that are completely in character with the rest of the subject is an advantage rather than the reverse, by filling up an otherwise bare blank space in a suitable manner. This can be helped further by focussing so that emphasis is put where it is needed, and the unnecessary is rendered unobtrusive. There is no objection to subordinate parts appearing out of focus—provided that they are not blurred in that intermediate manner which is so disturbing; that is to say, they must either be sharp enough for us to see what they are, or sufficiently blurred for it not to matter in the slightest what they are. Blurring is only really offensive when it attracts attention, by arousing an inquiry it does not satisfy.

The idea that the sitter must be close to the window is best thrown overboard at once. There is only one reason for it, and that is the shortening of exposure, dearly purchased at the expense of a satisfactory lighting and harmonious result. The nearer to the window the harsher the contrasts, and the more need for that very doubtful auxiliary, the reflector, with the danger of double and unnatural lighting it introduces. Many of the difficulties of home portraiture vanish by the model being placed well within the room. The question of space becomes much less troublesome, there is room to put the background well away from the figure, and, if need be, the camera may be placed so that it sees the sitter from a point much nearer to the source of the illumination. It is the fact that the lines joining the sitter with the light and with the camera respectively, often meet nearly at right angles when the sitter is posed close to a window, that helps to make the reflector so essential; as those lines close together, so does the lighting get flatter and flatter, until, when the camera is directly between the light and the sitter, exactly the opposite defect is introduced.

The time of exposure is reduced by this means to an extent quite remarkable to those who only consider the falling off in the strength of the light caused by distance from the window, and not the increased light in the shadow, which is the governing factor in exposing portraits, as in most other forms of photography. The north light idea is another notion which is best left to studio or regulation portraiture. There is no real reason why a portrait should not be taken in a room into which the sun is shining; in fact, the best portrait of the writer ever taken was made by Coburn, in a room undoubtedly designed as a bedroom, with a south aspect, and the sun shining in, but missing his head by an inch or two—thanks to the lower part of the window being curtained off. In that, the sun only helps the general illumination; but fine portraiture has been done with splashes of sunlight, actually used to help the effect. The north light and the sky light are both legacies from the studio of the painter; necessary to him from the conditions under which he works. Necessary also to the professional photographer, whose customers might regard the sunshine on dress or surroundings as a defect. They have

THE HOUSE ON THE WALL

BY CHARLES H. L. EMANUEL

come to look upon a certain kind of portrait as correct; and they won't be happy till they get it.

Under-exposure is as utterly ruinous in portraiture as in all else photographic. The directly visible result is in the exaggeration of the difference between the high lights. If there is any part of the subject lighter than the face, as there often is, the under-exposure leads to this being increased by over development, which usually accompanies it, until the face is quite unnaturally dark. This darkness is the cause of much wonderment to the beginner at times; as he is apt to expect that the face should be white—which it never is. He marvels, therefore, when it is darker than it should be; that in turn being darker than he thought. He is likely to over-develop, too, especially if he has had any experience with landscape work. A portrait negative should always look much thinner than a landscape; it has more tendency to strong compact high lights and a broader area of shadows, and it is absolutely necessary that its very highest lights should have printing value. "Stop development when you think it half done" is sound advice to the landscape photographer making his first attempt at portraiture. Only by exposure full enough for the deepest shadows, and density not too great for the highest lights, can we hope to get that truth of tone essential to a good portrait. Have as broad and as deep shadows as may seem fit, let the high light be a mere spot in its concentration and brilliancy, but let it have a value determined by the deposit on the negative, and not merely be the negation of colour.

Dress in portraiture may be as characteristic almost as the face itself; but its characterization is lost the moment it is worn for the purpose of the photograph, and that only. The work then passes into the domain of a figure study; where the dress may be assumed along with the expression, to convey some suggestion quite other than a likeness of the sitter. That field is a large one, and is very alluring; but needs to be trodden very carefully, if the pitfalls of anachronism and incongruity are to be avoided. There is so thorough a suggestion of the presence of the actual model before the camera, that the photographer who tries to deal with subjects of a bygone age, men in armour, Grecian damsels, Roman senators, and even sacred subjects and Biblical scenes, as some rash workers have

done, handicaps himself by the modernity of his process with all the weight of inevitable makebelieve. There is no reason why the model should not wear a fancy dress ; but it should be a fancy dress, and the deliberate introduction of a suggestion of modernity is then an artistic virtue, and not a pictorial crime. Otherwise the dress is best when it is a perfectly natural one. However sumptuous and ornate—and such dresses may be perfectly natural in their place—it must be subordinated to the sitter, or the sitter at once becomes a mere clothes-horse. Perhaps such a result may be sought. There are circumstances under which it would be the most truthful—and cruel—portraiture ; but the result would be hardly likely to be pleasure giving.

A point of much importance is the general tone of the costume. A poor complexion is helped very much by avoiding so light a tone in the clothes that they accentuate it. It may be noted, in passing, that there is always a tendency for flesh tones to come too dark—a tendency that will only be overcome when we have the perfect colour-sensitive plate. Without a screen, orthochromatic plates in portraiture will not be found to give noticeably truer renderings, while a screen is usually out of the question. A good complexion will often stand a very light dress, and treatment altogether in a high key, circumstances must be allowed to decide ; this high key demands more skill as a rule, but the result often more than repays for it.

Portraiture out-of-doors removes at one sweep the bugbear of long exposure, since this, under all ordinary circumstances, comes down to a second or two. The mistake most often made with such work is the attempt, by the use of plain or other backgrounds, and by similar devices, to get what are essentially indoor effects of lighting. It is as wrong to try and get such results out-of-doors as it is to get sham outdoor pictures indoor ; both are worse than crimes, they are blunders, and in art the Talleyrand epigram has real justification. It is possible by putting the sitter in the angle of a wall, cutting off top light with some screen, and generally dodging the illumination, to get something that may pass in a crowd for an indoor effect; but it will never justify the trouble taken. After all, people have been seen out-of-doors, some even have gone so

TENNYSON

BY MRS. CAMERON

far as to spend quite an appreciable part of their lives in the open air, so why should not the fact be boldly faced and made the most of? Those who have attempted genuine outdoor portraiture have accomplished some very delightful pictures; and, compared with many other paths, this one has been curiously untrodden. There should be little or no need for a warning against such offences as evening-dress in a sunshine picture, or slippers in a snow scene, though both have been perpetrated and *shown.* The shadow thrown by a hat need not be unpleasant, it may even form a delightful tone just where it is wanted, and the contraction of the pupils of the eye in the strong outdoor light is not unnatural. The commonest fault is found in the attempt to make the portrait far more than a portrait, to turn it in fact into a landscape and figure. The result is that fear of over-exposure for the landscape leads to under-exposure of the true subject, the sky comes out hard and white, and the face of the model almost black. Even when the exposure has been right, the enormous difference between the face and the sky may prove more than the plate can register properly, and the tones are untrue and have to be modified by some form of "faking." The easiest course is to avoid the inclusion of any sky in the picture at all; by doing this, and by taking great care to subordinate the setting to the subject, although not attempting to suppress or to conceal the fact that it is an outdoor and not an indoor picture, it should not be hard to get successes from the first, which might not be completely satisfying but are at least full of encouragement for the future.

Groups are the hardest subjects with which to deal in portraiture, and a group of more than three or four is seldom anything except a collection of persons standing still to be photographed, and all that we can hope to get is a good record of that occurrence. Occasionally we may meet with exceptions, and a croquet party, a few people waiting for a train, or saying good-bye, or otherwise engaged in some occupation which may be common to all, may inspire the photographer; but this will be seldom. The best he can do is to arrange the group so as to get little absolute uniformity in the pose of its components, and at the same time to see that they form a group and not a series of disconnected units. A natural background is a

necessity in such a case, and may be foliage, or a building, as circumstances permit. The mere recording is easy enough ; it is when the photographer has higher aims that the difficulty of the group appears.

The hands play a part in portraiture, which ought never to be neglected. "Show me the hands in the print, and I will tell you what I think of the photographer," said a colleague to the author, as they were judging an exhibition together. The speaker had achieved more than local fame in figure work himself, and in all his sympathetic treatment of the hands was noticeable. Perhaps no finer example of this could be wanted than the "Aubrey Beardsley," by F. H. Evans (facing this page), where that clever worker has succeeded in conveying as much by the wonderful hand of that eccentric genius as by his no less remarkable physiognomy. Mrs. Kasebier, in reply to a remark upon this same subject, brought out a collection of photographs of hands and nothing else, which was at least proof of the deliberate study of a feature, whose chief interest to many photographers seems to be conveyed by the remark, "How am I to get rid of the hands?" Rather should it be, "How am I to show the hands revealing the personality that lies in them, as it does in the face, at the same time subordinating them to it?"

Portraiture by artificial light is more a professional photographer's stern necessity than the amateur worker's delight. Flashlight work is curious, but seldom pleasing. This is due in large measure to the impossibility of deliberate study of the lighting effect beforehand, and to the improper placing of the flash, which is the inevitable sequel. If a flashlight portrait is to be attempted, the best effect will be found to be given when the flash is arranged as high above the sitter's head as it is in front of him, so that the greatest light falls at an angle of about 45°. This is mere rule-of-thumb, and is open to many exceptions. A diffuser of thin tissue paper or tracing paper is useful, when it does not catch fire, and very careful attention is necessary to prevent the presence of all kinds of unexpected shadows and reflections. Economy in flash powder at the present price of quarter-plates is false economy, only justified when the photographer has to stay in the room for some time afterwards in company with the smoke. All "smokeless" flash powders

AUBREY BEARDSLEY
BY FREDERICK H. EVANS

the author has seen, and he has seen and tried many, were only smokeless before they were lit.

The most effective use of magnesium in portrait work lies in its employment to obtain firelight and lamp-light effects. The light from a fire is strong enough to the eye, but so slight is its action on a plate that portraiture by it is quite out of the question. But it may be supplemented either by a concealed flash-lamp, or by using flash powder or magnesium ribbon, without any falsity of effect, if the arrangements have been properly made. Flash powders are convenient, but must be handled with great care as they are all essentially explosive, though there is a difference between some and others as far as risk of accidental ignition is concerned. Still the safest plan is to regard all as explosives and handle them accordingly. They should never be kept in a stoppered bottle, for instance, where there is a risk of grinding against the glass. Flash-lamps, that is to say lamps constructed to project powdered magnesium—not the same as flash powder, which must never be used in a lamp—are safer, and on the whole are to be preferred. There is less risk of startling the sitter, and it is easier to control the exact moment of ignition. The Platinotype Company introduced a lamp for burning magnesium ribbon in oxygen gas, by which a very powerful light could be obtained, and the light being enclosed in a globe, no smoke got out into the room.

A chapter on portraiture would hardly be complete without some reference to retouching, but most that need be written on this subject will be found dealt with in Chapter XX. Retouching is at the best a painful concession made to his customers by the professional photographer. It is employed, justifiably, to remedy minute defects in the plate, and to counteract its tendency to darken the flesh tints. This it does at great risk of destroying characteristic modelling and texture, and of lessening likeness. If it must be used, it is best done vicariously; since it is in no sense a photographic process, nor is it easy to imagine any one delighting in it as a hobby. In pictorial portraiture it is seldom necessary to render the skin with such microscopic definition that retouching becomes an object at all, and if by any chance this has been done in the negative, the employment of a matt and not a glossy surface printing-paper should remedy matters. If it does not, a sheet

of celluloid, matt on one side, interposed between negative and paper during printing, will remove that intense definition, which, in its way, is almost as bad as over retouching, and may be quite as false.

The photography of the lower animals is not so different in essence from the photography of the highest animal, as to call for much distinctive treatment here. Most that ought to be said is more a matter for the naturalist than the photographer, and Mr. Douglas English, whose delightful work is so well known, has given us in his book, "Photography for Naturalists," such a full and explicit description of his methods and results that those who follow that wide and fascinating branch take his instruction as their guide. Pictorially, animals often form both intelligent and beautiful models. They are free, to a large extent, from that conscious pose which in the human model is often the despair of the photographer; though that they are entirely free from camera consciousness, or at least some notion that they are required to look their best, is not the opinion of many of those who have had much to do with the photography at least of dogs and horses. Mr. Wastell's lion (facing this page) shows camera consciousness of another type; but in that case the photographer has seized the opportunity much as one would expect the lion might do, should it occur. For the rest, he will succeed with animals best, who is enough of a photographer to recognize the importance of tone value as well as outline, and enough of a naturalist to know how to treat his models so as to get their confidence and co-operation. Stirring a lion up with a stick is all very well for a wild beast—the wilder the beast the truer the portrait it may be contended—but domesticated animals may be expected to respond more readily to a gentler and more sympathetic treatment.

A LION

BY W. L. F. WASTELL

CHAPTER XXIV

PICTORIAL PHOTOGRAPHY

John Richard Green on photography—Distinction between pictorial and technical work—The picturesque in nature—Subject and treatment—Laws of "composition"—Chiaroscuro—Breadth—Composite printing—Clouds—Aerial perspective —Truth of tone—Key—Early pictorial workers—Hill—Rejlander—Mrs. Cameron—H. P. Robinson—Davison—Emerson and "Naturalistic Photography" —Present position of pictorial photography—The R.P.S. and the London Salon of Photography—Position in the United States—The Photo Secession— "Camera Work"—Stieglitz—Position on the Continent.

PROCESSES and methods absorb the lion's share of the photographer's attention, and much that is written about photography deals with them; but, after all, the narrowest technician would admit, in words at least, that these processes are only means to ends. The end in some cases is a faithful record of certain facts; and to many this is the highest ideal before the photographer. To them the camera is a machine for making perspective representations of objects put in front of it, and nothing more. They are quite unable to realize that the nature of that rendering depends very largely upon the user of the camera, or that the rendering by photography may be absolutely false and misleading or astonishingly true, according to his will and his power; and the common explanation of the fact that one man's work is better than that of another is conveyed in some such a phrase as "He must have a very fine camera."

Of course, this is very wide of the mark, as most of us know. A man does not have to use his camera long before he realizes that his own skill plays a very large part in the results obtained with it. This is so, even when the most at which he aims is a technically good, bright print of what was in front of his apparatus. Such a print is generally what the photographer

strives for in his novitiate; and it is an excellent ideal at the start, because its production is evidence that the simpler processes have been mastered. Such a print will not include so wide an angle as to convey a false impression; its definition all over will bear the most critical scrutiny, it will have a good colour, be free from blemishes of any kind, and will take full advantage of the capacity of the printing process to render gradation, its extreme high lights being almost, if not quite, white paper, and its deepest shadows the darkest tone the process will give. When this ideal has been reached, and, unfortunately, many photographers never attain it, easy as it is, many stop. It provides good firm ground for a great deal of useful record work. Botanists can employ their time in depicting flowers and leaves and stalks; naturalists poke their cameras at birds' nests and arrange traps by which wild beasts photograph themselves; architects and engineers protray buildings and structures, while in conjunction with the microscope and other 'scopes, microscopists and other 'ists, obtain delineations that can be studied at leisure. We must not overlook the fact, also, that an immense proportion of the portraiture that is done both by professional and amateur is strictly of this description; and that, were it not, it would fail to satisfy those to whom at present it is a delight. It was John Richard Green who wrote that "in counteracting the tendencies, social and industrial, which every day are sapping the healthier family affections, the sixpenny photograph is doing more for the poor man than all the philanthropists in the world." And the joy which the sixpenny—and the six-guinea, for that matter—photograph confers is one which is based strictly upon the technical fidelity with which it registers the externals of the subject.

While no one who sees many photographs can doubt that this is the case, we are confronted with the fact that the principal photographic exhibitions are conducted on quite different lines. The perfect technical print, as such, is apparently not wanted there at all. The work which is spoken of most highly by the critics may not comply in any way with the ideal just described; and the great photographic public will look, and wonder, and pass on. Here and there it will find a spokesman, who will talk about "the fuzzy school," "the cult of the spoilt print," and similar things, and the man

in the street will agree with him, though perhaps only *sotto voce ;* but the exhibitions go on their way, and the real direction of photography is left in the hands of those to whom many of the "spoilt prints" appeal. The reason for this is that every now and again some of these pictures do strike a sympathetic chord in the heart of the majority, and when they do, their superiority is manifest and unquestionable; and that being so, the majority seem content to take the rest on trust. The "man in the street" will look at one of these pictures, much like Fernando in the ballad, who "knew 'twas very clever, but didn't understand it."

The broad line of distinction between work of this kind and the good "technical" photograph is, that the former is intended solely to give æsthetic pleasure by conveying some feeling or suggestion from the artist to his public, while the latter is limited strictly to a statement of facts. It is the difference between the click of the telegraph and a sonata, between the price list and the poem. Æsthetic pleasure is the aim of one, instruction the object of the other. It is necessary to point out that between these two lies a vast body of photography which is without aim, produced simply to pass away time with its production. Photography is as good an amusement as any, and better than most ; but the photographer must not confuse the idle snappings of a shutter with work deliberately done with a pictorial motive.

The picture must have in it some of the personality of the artist, and not be a mere transcript of some actual arrangement of things in nature. Natural, in the highest sense, it must be ; but it must be a personal or an individual rendering of nature, and not a diagram. The difference between the actual position and colour of objects as they might be ascertained with a foot-rule and a spectroscope, and the suggestion which the scene makes on any beholder, is infinite. The one has no reference to the spectator whatever ; it exists, not to diverge into metaphysics, irrespective of him entirely. The other must differ with every observer, and the impression can only be conveyed by an artist who can give something more than the bare scientific facts.

The means by which the photographer can do this are the same as those at the command of the painter, subject to the

limitations of his process. The first—the very simplest—is in the choice of his subject. There is a tendency on the part of most photographers to attach too much importance to the sumptuary details of the subject, and still more a tendency on the part of the exhibition-going public to consider those to the exclusion of everything else. "I cannot see why he took that" is an exhibition banality we have all heard, just as we have its reverse, "What a pretty tree!" or, "What a fine sunset!" There are some photographers whose photographic lives are spent in a search after effective subjects — "picturesque" material so arranged by the hand of nature that the photographer can get his camera to some place where his view of it will comply with the various "laws of composition." The great majority of people who visit photographic exhibitions —that is to say, most photographers and many others—regard "subject" as of the first importance; indeed, it is doubtful whether many of them realize that there can be any other pictorial qualities at all, and would be inclined to assert that a technically perfect rendering of a "fine subject" is the final aim of the picture-maker. If this were so, there would indeed be very little in pictorial photography.

There are many scenes in nature which are very pleasant to look at. The picturesque appeals to us all, and appeals as strongly, or even more strongly, to the artist than to others. But the pleasure which is caused by a photograph of a picturesque spot is quite a distinct and different feeling from that to which a picture gives rise. The picturesque spot may provide painter and photographer with subjects, and may excite and keep up that love of nature without which no artistic work can be done, but the careful, painstaking copy of it is not of necessity a work of art. Reliance upon subjects which are of recognized, not to say hackneyed, sentimental interest—waterfalls, Gothic ruins, rustic bridges, sunsets—is a sign of weakness and mediocrity. The power to see poetry in an everyday event or scene, and to convey to others its impression, is the highest possession of the artist. The fuller his vision, and the more complete his control over his means, the less is he trammelled by the feeling that it is only with certain subjects he is able to deal. This is a truth that comparatively few are able to appreciate in pictorial art, though no one doubts it in literature.

TABLE TALK

BY HERBERT MILLS

"He touched nothing that he did not adorn," wrote Johnson of a literary artist; while Lamb was able to expose to us his delightful temperament, whether he wrote of the early dramatists or of the discovery of roast pig. So the photographer, who wanders about seeking always for the picturesque, is putting a comparatively unimportant detail in the forefront of his requirements. What he should seek is not the sentimental or the striking, but rather what will allow him to express his own personality. Precisely what this is must of necessity vary with the photographer. What is one man's meat is another man's poison; and one man may find a district teeming with opportunities which to another is altogether barren. The latter is not, of necessity, less of an artist than the former; he may simply be out of sympathy with his particular environment. Subject will never make a work of art, while treatment may glorify the most unpromising of subjects. It is over the recognition of this that five-sixths of the photographic world still boggles, although it bows to the decision of the remaining sixth as far as yielding up to it the control of its exhibitions is concerned.

What, then, is this "treatment"? Its externals are the selection of the subject, and will decide its arrangement on the plate, the tone values of its various parts, then definition, the scale of the finished picture, its key, and finally the little details of the print and its setting, in the shape of frame, mount, etc. Some of these are comparatively unimportant, but it is never wise to ignore them in the hope that the other factors will prove so powerful that the rest can be overlooked.

This is particularly the case with the art of photography, because in certain directions the photographer is so much more limited than the painter that minor matters about which the painter troubles little are almost vital to him who uses the camera. Mounting, framing, and hanging may well be taken as extreme examples of this. There has been a very great improvement in the taste shown in these matters during the last twenty or thirty years, not limited by any means to photography. Except in such places as the Royal Academy, where tradition reigns supreme, it is recognized that the appeal and force of a picture may be increased manyfold by careful study of the conditions under which it is seen, while it may be

almost neutralized by neglect of these conditions. The full force of this was first realized by photographers, and it was their example which was followed by the painters and others, as is shown now by almost every picture exhibition.

We must realize in pictorial photography that we have much more to do than to record a natural and fortuitous grouping of things. The painter decides for himself what he shall put in his picture, and where each part shall go. The photographer has not such a free hand, so that composition in the strictest sense of the word is not open to him, and he has instead selection and arrangement. His picture has got to suggest something far more than a map of the subject before the camera, and to do this the very first opportunity lies in the decision what to include and what to leave out.

There have been a number of well-intentioned books written for the guidance of the photographer on this important subject, some helpful, some the reverse. Most of them, from the "Art Essays" of Burnet downwards, deal with what are called the laws of composition, generalizations drawn from the study of the great masters. The study of these rules is very interesting, and their application to pictures an entertaining pastime, but it is little more. No study of the laws of composition will make an artist, nor is it possible to arrange a picture by carefully selecting and placing each part in accordance with rule. No great picture altogether ignores them, or perhaps it would be truer to say that they will be found to hold good in all great pictures; but it is impossible to conceive of the artist putting this here because of one rule or that there because of another. His picture was what it was because he felt what was right and did it, and any attempt to follow formal laws would have robbed the whole work of spontaneity.

The photographer in his own sphere must do the same. If he does not feel the weakness of putting the dominating point of interest in the mathematical centre of the picture, he is not likely to improve his result much by remembering that there is a rule against it, and altering things accordingly. The introduction of something to balance something else already there and unsupported will not be a success if it is done because of a deliberate examination to see if the law as to balance has been observed. It must be put in because without it there is a

WINGS OF THE MORNING

BY CHAS. T. WANLESS

distinct feeling of something wanting. There is no harm in turning to one of H. P. Robinson's books or to Burnet, afterwards, if the photographer is curious to know what has been said about balance.

Composition is not to be learnt from a set of rules, but from the study of pictures themselves; and in so doing it is far better to go to the painter than to the photographer. To start with, the painter has been at his art much longer; pictorial photography has hardly yet attained to threescore years and ten. Then the greatest masters have always been found in painting, because of its greater flexibility, and always will be. Cheap and good reproductions of the world's greatest pictures are so easily obtainable that there is no excuse for ignorance of them. The best, too, are reproductions in monochrome; and though much of the charm of the original is necessarily lost, they are, if anything, even more valuable to the photographer from the absence of colour to distract his attention. Such a series as that issued by the Autotype Company will provide material for study that is unsurpassed. It may be said, How can such copies in themselves teach the photographer anything? How is he to get any lesson from them, or to know what to draw from each? It is not possible to tag on to every picture an artistic moral, nor can art be learnt quite like the kings of Israel and Judah, or the French irregular verbs; but much can be done by reading judicious and not too didactic criticisms, by the comparison of one work with another, by the study of books written of artists by men who were in sympathy with them. Even then, unless the student has an artistic temperament at first, he will not profit much by such labour. The germ must be there; but, once there, it is susceptible of infinite cultivation. It has always seemed a strange thing that many photographers attempt to produce pictures by photography, when the slightest self-examination should surely show them that they are without the slightest æsthetic sense. They seem to regard it much as the man who didn't know if he could play the fiddle because he had never tried, but, unlike that cautious individual, they do try, but are unconscious that they fail. An exhibitor, who had distinctly lofty aims in pictorial photography, once casually let fall the observation in the author's

hearing that he had never been in the National Gallery. He was a Londoner. The incompatibility of the possession of the qualities that would go to make him an artist, with the entire absence of so little interest in art as was required to take him to see the national collection, never seemed to strike him.

The photographer does not need to learn the painter's technique, but every other side of the painter's education is essential to him. It is a handicap that his process is so easy, that, unlike the painter, in learning its details he is not at the same time increasing his art knowledge. In painting, these two things can and often do go hand-in-hand; in photography, never. This accounts in great manner for the success which painters meet almost at once if they master the details of photographic technique; they are able to transfer to their new art much of what they learnt in the old. It is a strange comment on pictorial photography, that such a thing as a photographic art school, or even a class where photography is regarded throughout as a means of pictorial expression, has hardly been mooted. Certainly no serious attempt has ever been made to form one.

Composition or selection is the first stage toward the completed picture. To the photographer, it is probable that a picture will be more definitely and consciously suggested by nature, than to the painter, from the difference in their methods. To think out beforehand a landscape subject, and then to seek photographic material for it, though not so improbable as it seems at first thought, is rather putting the cart before the horse. In figure work, the photographer has fewer limitations, and can realize his conceptions with comparative ease, except in the case of the nude, which is not impossible, but almost impossible, photographically.

Chiaroscuro, literally light-dark, the disposition of the principal masses of light and shade in the picture, is, in photography, the result of the selection of the subject. The arrangement of a photograph may be looked at in two lights—as a design in grouping of tones, and as the disposition of the most salient lines. The two are interconnected, but far from being one and the same, the tone scheme being the more important consideration of the two. This is altogether irrespective of the

particular things which happen to be represented in the picture; so much so, that it may safely be said that we should derive a certain pleasure from looking at the picture even if we did so under circumstances which prevented us altogether from distinguishing what any part of it was intended to represent.

The quality known as "breadth" is one of which critics love to talk, and one which "the man in the street," as he cannot get a simple definition of it, is disposed to look upon as a kind of pictorial Mrs. Harris. In photography it is secured in more ways than one, and it may perhaps be defined negatively by saying that it is the characteristic quality that is *not* present in a sharply rendered, bright, clean photograph, taken in a good light. Its absence in the simple lens picture marks an essential difference between it and the visual impression. There are subjects in Nature, occasionally, which a simple and straightforward photograph will render broadly; but they are not common. This quality of breadth is not to be obtained by the use of any one photographic trick, though there are several whose assistance may be wanted at different times to secure it. An example may perhaps make this clearer. In one part of our subject we have a mass of foliage, which in the sum total of its tone is what we want in our picture; yet if we turn the eye directly towards it and study it, or if we photograph it in a straightforward manner, we shall find that that sum total is made up of a number of bright and dark patches intermingled. If these are broadly treated, we are not worried in the picture by their spottiness, and we represent them by a tone which sums up their effect *en masse.* To do so in such a case calls for direct personal interposition in some way or another, the actual method depending on the printing process employed and other circumstances. Sometimes it is possible to do what is necessary by focussing, keeping the important parts sharp, and letting the rest be diffused; but often this is not practicable, and handwork is a necessity. The appearance of fine definition in a picture is always a mistake. By this is not meant that the picture need be blurred, or even need be anything but critically sharp, but simply that, on looking at it, the thought that it is sharp should not be what it suggests. The actual definition has little to do with this sensation, which is always the outcome of a lack of breadth. A picture may

have remarkable definition all over, and yet not suggest sharpness; though in consequence of the difficulty of dealing with unnecessary details in a sharp photograph, such a case is not common. Still the feeling that a picture is very sharp is more a matter of subject and treatment generally than of mere definition by itself.

The actual selection of a point of view is not the only control the photographer has over his subject; he can add to it by making his print from more than one negative, while by handwork in printing and on the negative he can often remove, or at least suppress, unnecessary details. The commonest case of addition is in the printing in of clouds. It is possible to do this effectively, as photographs have shown; but it is very rarely that the result is completely successful. The more carefully Nature is studied, the more apparent does it become that every light and shadow in the landscape is directly but subtly connected with the forms and tone of the sky above · and that even if no perceptible seam divides the composite photograph, there is not a complete feeling of unity in the picture. Modern orthochromatic methods enable us to get clouds and landscape on the same plate, and if the cloud forms to which they limit us are not always exactly what we would have them, the gain is greater than the loss, as pictorial workers seem to appreciate more and more as time goes on. There is at least the certainty of a more complete harmony throughout, than when two negatives, taken perhaps under very different conditions, are employed.

Closely allied to the subject of clouds in landscape is that of aerial perspective. Geometrical perspective the photographer may leave to his lens, which will give it with an accuracy which is the ideal of the painter and draughtsman, but aerial perspective is far otherwise. The sense of distance is conveyed to the brain not merely by the scale of different objects, but also by their tone and colour. With the latter the photographer is not so directly concerned as with the former, but the effect of distance on tone is a vital one to him. A dark object appears lighter and lighter as it recedes from the eye, since it is viewed through an increasing depth of illuminated air, and similarly, but to a less extent, a light object is darkened by distance. It is possible to imagine a world of dustless air,

or even an airless one, wherein aerial perspective was not, and fanciful attempts have been made in pictures to represent such a world, which the moon is supposed to be. A lunar landscape we may conceive as having no aerial perspective. The shadow of a distant mountain is as black as would be the shadow of the camera itself, and the outline of each would be as sharp and cutting. The background of the sky in such would be of inky jet, on which the stars shone out in broad daylight more brilliantly than they can ever be seen from the air-clothed earth. We are more fortunate.

The effect of the atmosphere upon different planes of a picture is twofold. The more distant a dark object the lighter it appears in tone, and the less sharply defined are its boundaries. Under favourable conditions the camera may reproduce both these effects faithfully enough. The most perfect lens will not give as crisp a rendering of a distant object as it will of one that is close at hand, if only the exposure is long enough for the atmosphere to exert its influence on definition, as those who do much telephotography realize to their discomfort. In the same way we may get a print in which, without any conscious effort on our part, the camera has given us the effect of the air on the different planes: one, that is, in which there is the true aerial perspective. This does not always occur, by any means, and the photographer may find that he has got by some device or other to remedy the shortcomings of his process. As a general rule, there is a great loss of atmosphere in a straightforward photograph taken in clear weather. When the sun is low, when there is mist about, and especially when there is rain, the aerial perspective in the print will correspond far more closely to that which we perceive with the eye. The abuse of the orthochromatic plate and colour screen tends to deprive the picture of what is a valuable aid to its appeal. The fondness of photographers for grey day and evening effects is largely due to conscious or unconscious recognition that their process is better able to give good aerial perspective then than in bright sunshine. In the latter case it is almost always necessary to employ manipulation of some kind to keep the more distant planes of a tone true to the rest of the picture.

No pictorial worker questions for a moment the importance

of truth of tone, or "tonality," as it is sometimes called; yet the haziest ideas seem to prevail as to the real meaning of the expression. One voluminous writer has laid it down that the aim of the photographer is to secure a rendering in which the lights are as bright and the shadows as dark as they are in Nature; and some vague notion similar to this seems often to be entertained even where the photographer's own work shows that unconsciously he is aiming at something very different. Except in some very few cases of indoor figure and similar work, nothing approaching such a rendering is possible. The photograph is generally on white paper, and its highest light therefore can never be lighter than plain white paper seen in the subdued light of a room, while his deepest shadow cannot be darker than the same paper blackened by the printing process employed carried as far as it will go. Beside a deep foreground shadow out-of-doors such a black is seen to have quite a light tone, while held against the sky, or still more against a splash of sunshine on a whitewashed cottage, the white paper in diffused light appears very dark. How then can we obtain truth of tone in a photograph?

Truth of tone has nothing whatever to do either with the actual lightness of the highest light in the print, or the actual blackness of the deepest shadows. This is a question of key only. By truth of tone we mean rather that between the two extremes, which may be as near together or as far apart as we choose, the other tones shall occupy positions which are relatively correct. This may be obtained by pure photography, provided that the subject is one within the range of the plate, and the exposure given is correct. The technics have already been considered in Chapter X., and what is there written need only be supplemented by pointing out that the tone values in the print will only be correct provided the negative has not been over-developed for the printing process employed. Under development does not affect the values, but only the key. Subject therefore to the orthochromatism of the process, tonality is dependent upon the way in which the exposure has been timed, and development adjusted to the printing process. The quality sought so painfully by the painter, can be attained in photography by comparatively simple means. A far-seeing critic has said its power of

rendering tone values correctly is the greatest and most valuable of the qualities of photography.

The photographer can, to some extent, control the key of his picture in development, by carrying on the process or by cutting it short; the prevailing fault being such over-development as results in false tonality, by the closing together of the high lights. As these are often concentrated in the sky, where colour plays a large part, and where orthochromatism is very important, the defect is exaggerated. The selection of a printing process also allows the key to be controlled, as does the depth to which printing is carried. But all these are only means by which the real determining factor may be influenced a little one way or the other; the nature of the subject, the prevalence of deep shadow relieved only by bright concentrated light, or *vice versâ*, deciding the keynote of the whole. This is well seen by comparing two such pictures as "The House on the Wall," by Emmanuel (facing p. 356), and Coulthurst's "Evening on the Marsh" (facing p. 384), which may be taken as representing the two extremes.

It was by the adoption of a low key for grey day effects, and by their fondness for such effects, as well as by the free use of diffusion of focus to secure breadth, that the "impressionist school," as they were not too accurately termed, called down upon their heads the wrath of those who looked upon its definition and detail as the great merit of photography—as indeed it is in record work—and regarded the utilization of anything short of the entire scale of the printing paper as a crime. There still linger technicians who believe, or affect to believe, that a grey day effect is grey because the photographer could not make a negative with more contrast if he would; and that the diffusion of focus in a picture is there because its producer could not afford a better lens, or perhaps did not understand the use of stops. Far be it from us to disturb such a peace-giving creed. It harms no living soul, and must be inexpressibly soothing to its possessors. But they are getting rarer and rarer; and the photographic world has come to accept sharpness or diffusion, vigour or delicacy, brilliancy or softness, as alike legitimate, provided any are employed not haphazard, but to secure the effect that is desired.

How each of the different qualities which have been referred to is to be employed in any finished picture, how far that shall depend upon the mere guidance of the camera and what are called processes of pure photography, and how far upon the direct intervention of the photographer, each must decide for himself. Since, in pictorial photography, there is no direct attempt at imitating some particular scene in Nature, there need be no hesitation about using any or all the means at our command to produce what we want.

Those who think that pictorial photography is a product of the last quarter of a century would do well to study the work of David Octavius Hill, a Scottish painter, who turned to photography in 1842, originally to help him in his painting. He soon became fascinated with his new method. Some of his portraits are not surpassed by anything that has been done since, although Hill had no other process than calotype at his command. A volume of his work is in the possession of the Royal Photographic Society, and his negatives are still in existence, so that it is possible that one day they may be published. After Hill, the history of pictorial photography in England shows a long gap. The wet collodion process was being perfected, and the extraordinary detail and delicacy of the pictures obtained with it, took photographers away on a totally different track. Mid-Victorian tendencies were shown as strongly in photography as anywhere, and able workers lost themselves in morasses of false sentiment, and swamps of elaborate theatrical unrealities. Rejlander, a Swede, who came to England after an adventurous career on the Continent, studied as a sculptor and painter, but, turning photographer, endeavoured to get a living by professional work, and at the same time to practise photography as an art. Rejlander and, later, H. P. Robinson carried combination printing as far as it was possible to do, one of the former's most notable pictures having more than twenty figures, separately arranged and photographed. It is easy to sneer at such things now—we have travelled far since "the Railway Station" and "the Derby Day"—but in their time, and amongst their generation, these men did much to keep up the recognition of photography as an art, whatever may now be thought of the lines on which they worked.

Contemporaneously with them lived a lady, Mrs. Julia

A CASTLE OF ROMANCE

BY JAMES MCKISSACK

Margaret Cameron, who exercised a considerable influence upon those who came within her circle, and was fortunate enough to include in this category many of the well-known men of the time—amongst others, Herschel and Tennyson. Mrs. Cameron realized what few could then appreciate, the difficulty of dealing with the critically sharp definition of the portrait lens, and it was to meet her requirements that instruments were made with an adjustment by which any required degree of spherical aberration could be introduced at will. Her portrait work is characterized by a breadth and force seen in that of no one else since the time of Hill, and it is only by one or two modern workers, of whom Steichen mav be noted in particular, that the succession is maintained.

Mrs. Cameron died in 1879, just as the dry plate was being perfected, and during the next few years there is little to note in pictorial photography, except that the modern amateur movement was gradually gathering force. By 1885 it was in full swing; photography had once more become a craze, and interest was manifested in it by thousands. The Camera Club was founded, and in its early days was a social centre for pictorial workers, although these were only a small minority of its members.

Photography was now to feel the effects of the sweeping change in art which characterized the last quarter of the nineteenth century. In 1888, Dr. P. H. Emerson published "Naturalistic Photography," a work which has been compared to a bombshell dropped into the midst of a tea-party. Manifestations of the change, as far as pictures were concerned, were shown at the exhibition of the Royal Photographic Society in 1900. Davison's "Onion Field" took the photographic world by storm. Photography had taken little count of the trend of art, and when Emerson and Davison drew attention to it with a jerk, old-fashioned toilers at composite photography found the ground moving from under their feet, and their palace of art, a respectable stucco-fronted mansion, collapsing over their heads. The earthquake passed away, but its effects remain to this day. Impressionism was to have its place in photography as in the other graphic arts; and the conventionalities and unreality of thirty years were left behind in three. "Naturalism" was the text preached from by Davison,

Emerson, and others, and their influence was immediately seen in exhibitions, both in subject and in treatment. Davison had gone to the Essex marshes for some of his best-known pictures, and a weekly exodus towards Canvey Island and the Blackwater followed, which must have had its effect upon the dividends of the Great Eastern Railway. It followed that going down into Essex, photographers must need discover Constable's country, and the discovery was not without its result on English photographic landscape. The "Mud Flat School," as it was termed, broadened in its views until its name ceased to be appropriate.

The characteristic of present-day photographic work in this country is its atmosphere, its appreciation of the beauty of cloud form, and the reliance often placed upon the sky to provide the real subject of the picture. These, of course, have always been essential features of British landscape art, and in this photography is at one with painting. But mediocrity seems to be the note to-day, and the centre of interest, as far as pictorial photography is concerned, has shifted across the Atlantic. No one seeing our exhibitions year by year can fail to observe that, while the number of workers of some note has increased, there has been no increase in the interest of the pictures shown.

Some have explained it as levelling up, others have called it stagnation. Certain it is that the leaders of twenty years ago have been caught up by those who followed them; but it is not so easy to determine whether this is due to the progress of the one or the lack of movement of the other. The great increase in numbers has been brought about by the extraordinary simplicity and ease of modern methods, which have attracted thousands to photography who would never have thought of it otherwise. Here and there amongst the number have been some who realized that the amusement of an idle hour might be made much more, and that in the camera they might have a means of expression, which lack of inclination or lack of training had prevented them from finding in the pencil.

The "Linked Ring" was an association of pictorial photographers, mostly British, which took its origin in a personal squabble in the Royal Photographic Society, but was inevitable

in some form or another. It held an annual exhibition—"The Photographic Salon"—but eventually internal dissensions and a general lowering of its aims and ideals led to its collapse, some of its members forming a new association, and the others remaining more or less unattached. The "London Salon of Photography" represents the more academical side of the former "Linked Ring," but the causes which brought the older body into existence have ceased to be; and the "London Salon" finds its chief excuse in the apathy of the Royal Photographic Society. This latter also holds an annual exhibition. The two shows are to a certain extent rivals, and are open simultaneously. The older body, however, has to cater for more than pictorial photographers only, and its pictorial section is only a section, though the most important one, of the entire exhibition. There is much to be done both in Britain and on the Continent to secure the inclusion of pictorial photography in the category of art; and in this, as might have been expected, the New World has taken the lead.

In the United States the last few years have witnessed a considerable change in the attitude of the art world generally, but of the painter more especially, towards photography. Much of this has been due to the publication there, by Mr. Stieglitz, of a series of quarterly volumes, beside which nothing else can be placed. First as "Camera Notes," the official organ of the New York Camera Club, and then as "Camera Work," an independent publication altogether, this series, by familiarizing the art world with the work of photographers, by means of the most careful facsimiles in photogravure, and by its persistent teaching, has had its effect. The loosely formed union of photographers calling itself the "Photo Secession," as indicating its independence and general attitude, controlled and directed by the same individual, has tended to the same end. Apart altogether from the particular pictorial work which the members of the "Photo Secession" have achieved, we must put the fact that it has come to be regarded by the Painters' Societies and by other bodies of artists as one of themselves; the Secessionists have had art galleries placed at their disposal in different cities, and have obtained a recognition for their art, which it has certainly not received elsewhere. To no one man can this be exclusively attributed, but the lion's share of the labour

has undoubtedly fallen on Alfred Stieglitz, as organizer, editor, and author, and it is to him that we turn to know how such a result has been achieved. He has been good enough to send us a note, which he entitles, "Some of the Reasons." It is perhaps best printed here exactly as he sends it.

"SOME OF THE REASONS

"All movements that have exercised any influence on the moral and artistic advancement of mankind have been actuated by abiding faith and hope in the hearts of the leaders. The mass is always quick to enthusiasm, but, like the Banderlog, just as quick to lose faith and to worship strange gods. Each revolution of thought has been founded by the fanatic, bigoted, and single-minded belief in its principles, which through thick and thin held sway in the minds of the very few.

"This principle has held true in the revolution which has convulsed the American photographic world for the past years. And to-day, when the photographic world has acknowledged, and the art world is in the act of acknowledging, the achievements of American photography, it is interesting to analyze the causes which have led up to these results. In photography, as in every other department of human endeavour, individual ambitions are the prime causes which lead to sporadically successful exploits; but it requires something more than isolated achievements to accomplish the aims of a radical movement. In their clear insight and recognition of this principle lay the power of the leaders of American photography. While ready to acknowledge the successes of the individual, they nevertheless insisted upon a certain subordination of the claims and ambitions of the one, in the interests of the cause which they believed in, fearing lest such limited and circumscribed views of the functions of photography, as would necessarily be held by the isolated worker, would result in making photography narrow and provincial—stifling the universal spirit which is essential to the life of every art. It was because of their adherence to this rule of partial suppression of the individual that the leaders were subjected to the reproach and

misunderstanding of those who would serve only their personal ambitions, and of those who failed to understand, because they lacked the knowledge, or were constitutionally disabled from appreciating, the motives of these leaders.

"It may be that the world's approval of the bull-dog tenacity of those who do not know when they are beaten was an element in the beginning of the success which followed the strict adherence to their rule. A certain respect was ultimately gained among those who began to feel that there must be some kernel of truth in a faith for which men were willing to sacrifice so much, and a reaction from the blind rage of the mob began to set in. Undazzled by growing successes, the American pictorialists, as a body—of course, there were always some stragglers—continued to tread the steep and narrow path which led towards the heights of their ideals, and to-day, while they have reached above the clouds, they distinctly realize that the pinnacle is still far above them.

"Of course, we in America fully acknowledge that in other countries there are enthusiastic workers who have done very much towards enhancing the dignity of pictorial photography, and even bodies of workers who have striven towards a goal; but it is borne in upon us that their spirit of loyalty and enthusiasm has been directed towards organizations, rather than towards broad and universal ideals. True to the American spirit, of which it has been said that even its transcendentalism and Puritanism have been tempered by practical considerations, there has been an incidental material side to all this, which the American worker fully realizes. Though the individual American photographer was subordinated to the success of the cause, yet, in its success, the individual was enabled to achieve, and did achieve, a far greater distinction than could ever have been his portion if he had been compelled to rely upon his unaided effort; and thus, while individual effort, ability, and talent have made possible the results of the American School, yet the recognition which is being accorded to photography, as a new and additional means of art expression, could not have been accomplished by the work of any one, no matter how inspired. As an example of this, there can be cited the accomplishments of one American, a painter-photographer, whose work has succeeded in clinching

the conviction, photographic and pictorial, that the claims of photography were entitled to serious consideration. Yet had the movement not prepared the way for an appreciation and active encouragement of his talents, they would have excited but sporadic and passing interest as the clever manifestations of a painter.

"The ultimate results no wise man will attempt to prophesy, but the future can in a measure be anticipated by an analysis of the present and the past; and, taking the accomplishments of the past few years into consideration, it would be folly to limit the possibilities. But even if its future strides be not as great as those just taken, yet there is already apparent in America one result which is fraught with great promise. Through the medium of carefully selected and restricted exhibitions there is being placed before such members of the younger generation, as are endowed with artistic feelings and desires, the ripest past and present achievements of photography, and the art student of to-day, who will be the painter of to-morrow, is learning, before prejudices and cant have narrowed his artistic soul, that photography not only may be, but actually is, one medium of individual expression.

"ALFRED STIEGLITZ."

CHAPTER XXV

EXHIBITIONS AND SOCIETIES

The display of prints—Albums—Exhibiting—The question of size—Framing—*Passe partouts*—Mounting in the American manner—The autumn and winter exhibitions—Copyright—How to register a photograph—Selling the right to reproduce—Prices of pictures—Prints suitable for reproduction—Amateur or professional—Photographic societies—Postal clubs—Journals and text-books—Photographic classes—City and Guilds examinations.

THERE are very few photographers who pursue their hobby for themselves alone, irrespective of the pleasure which they can bestow on their friends by its exercise, and therefore it is only in due course that, after dealing with the production of the photographs, we come to the question of their exhibition, under which heading may fairly be grouped all the different methods by which they are shown to others. If he had to please himself only, the photographer in many cases, we expect, would be satisfied with the negative, and instead of making prints from it would derive meditative gratification from the thought of the mighty pictorial possibilities it contained. But if good intentions form a satisfactory pavement for a well-trodden highway, they are a poor covering for the walls, either of a home or of an exhibition gallery; and the camera worker therefore has to realize his, as far as he can, if his friends are to judge of his work, or are to share in the pleasant memories which his prints revive.

The most popular application of the camera is as a travel companion, and it is in the results which we bring back from a trip to the seaside or to foreign lands that the greatest number of its users find the greatest pleasure. But if these are to be seen under reasonably favourable conditions, it will never do to show them as a tattered envelope full of dog-eared, unmounted silver prints, thumb-marked and pocket worn. Prints

that are worth showing to any one are worth careful trimming and mounting, and if they deal with a journey, or otherwise fall into a natural series, they should be so arranged. The slip-in album that is so popular is a device for sacrificing quality to ease. A packet of cut pieces of P.O.P. can be bought and printed, and the prints slipped into the album without any trimming whatever. Some people who use this device take the trouble to put a drop of gum where it will not show, to hold the print in position; but most photographers seem to prefer not to do so, that the album may have its contents changed as often as they like. The practice is a very slovenly one, and nobody who takes a pride in his work would resort to one of these albums—except to hold a set of prints as an index or catalogue of negatives. For not only do the prints shift about behind the opening, but this shows almost the entire surface of each print, and so allows no selective trimming at all.

The method by which the print is trimmed to shape has been described in Chapter XIV.; but what are we to say of its application? How many photographers realize the power they possess of improving the arrangement of the picture by the judicious use of the knife, pruning away all that is unnecessary or antagonistic to the composition, and placing the leading features in the most effective position with reference to the borders? This work is done by the painter as he paints, since his method does not compel him to fill a canvas of some predetermined size with all that is before him, on a predetermined scale. He paints what he wants on the scale he wants, and leaves the rest. Not so the photographer. It would be far more troublesome for him to omit what he did not want than to include it, and his chief aim at first therefore is to take care that all he will want for his picture is on his plate; and, if he can, to take care that it is as large as the plate will reasonably admit. But thanks to enlarging processes this latter is not at all a rigid requirement, and a picture of the size of two or three square feet is easily made from a little bit of a plate not much larger than a postage stamp, if the original negative is a good one. The selection of that bit from the entire plate is best made afterwards, when it can be studied leisurely in its monochrome rendering and the right way up. A mounted

EVENING ON THE MARSH

BY S. L. COLTHURST

print is best for the purpose, and then with a couple of L-shaped cards we can try the effects of different trimming, until at last we settle on that which gives what we think the best result. And if we value our photographic reputation, that and that only will constitute the print as shown to any one else.

For exhibition at home, the album is the most convenient arrangement. The slip-in album has been denounced, but there are other forms with some of its advantages, without any of its disadvantages. There are albums with plain leaves of any tint we care to select, which leaves are hinged and perforated and held into their covers by ribbons or laces. These allow the prints to be mounted on the loose leaves, and dried under pressure, so as to come out quite flat, and then permit them to be arranged and rearranged in the albums as often as we like. Moreover, if we made a mess of one of the pages, it does not form a blot on the entire book, as it does when the prints are stuck into a made-up album. For odd prints another popular type may be styled the higgledy-piggledy album. In this kind of album we have large cardboard pages, interleaved with sheets of toned paper with cut-out openings of different sizes and shapes. We can fit prints to the openings, and then mount them on the card so that they appear in the proper places behind them.

The "album de luxe," or the highest outcome of the collected photograph, is seen when each print is made on platinum paper with a broad white margin. Quarter-plate negatives may be printed on half-plate, or, better still, on whole plate paper, each being masked so that exactly the portion selected is shown, and on exactly the right part of the paper. To do this a mask is made for each negative of broad strips of black paper, just touched with gum at its extremities. The position of the full-sized piece of paper is marked on this mask in pencil, so that when the negative is placed on a piece of plain glass in the printing-frame, and the mask is put on top of it, we see exactly where to put our paper down. If the sky of the negative is very dense, or if there are very white objects right against the line of the mask, it is best when the print is finished to hold mask and paper firmly with one hand, to open the printing-frame and slip out the negative with the other,

and then, for a moment, to expose the paper to light behind the mask. A very brief exposure suffices and marks the boundary of the picture all round. Nothing looks so bad in this style of printing as a blank white in the picture, running without an indication of a dividing line into the white margin. When a set of such prints has been made, they may be arranged in order and sent to be bound up into an album, with a neatly written title-page, and then form the finest record of a tour which any photographer could wish to possess. The cost of binding depends, of course, upon the quality of the work put into it, and the style. When done in full morocco and in the best manner, this method of keeping prints is necessarily an expensive one, but the result is certainly unrivalled.

Besides the collection of prints into albums, the photographer will, perhaps, wish to try his skill with individual prints against those of his fellows in a photographic exhibition. Exhibiting is very fine practice, even if it does not lead to a collection of plaques and medals. In fact, it is almost better for the photographer if it does not, as it shows that he is competing amongst his fellows, or, at least, not amongst his inferiors.

The great advantage of occasional exhibiting is that it enables the photographer to see for himself how his work looks alongside that of others. To secure this he must exhibit at shows which he can himself visit. If he sends occasionally to one or other of the big exhibitions, he may be fortunate enough to get a candid and competent criticism of it, but this is not very likely. Detailed criticism of exhibitions is now seldom published in the photographic press; while the review in the local paper, seldom written with any knowledge of photography at all, has little or no value.

An award, at the best, expresses the opinion of the judge, or, perhaps, marks a compromise reached by a board of judges; but if the award is made by a judge who is known to be a competent critic—not at all the same thing as a successful exhibitor—some value may attach to it. At least the exhibitor will feel that he has succeeded in getting recognition from one who has some claim to be regarded as an authority.

In recent years there has been a tendency to revert to rather smaller sizes than were customary at exhibitions, the pictures

generally ranging from half-plate to 15 × 12 inches. At the more important shows there are seldom more than two or three which are smaller than whole plate; but at the various exhibitions held by local societies, the size ranges down to quarter-plate or smaller. For a picture that is to be sent to one of the leading exhibitions, 10 × 8 or thereabouts might be selected as quite large enough. As, nowadays, this will almost inevitably be an enlargement, the exhibitor can select the size irrespective of that of the original negative. Many of the pictures at the leading shows are enlargements from $3\frac{1}{2} \times 2\frac{1}{2}$ with negatives, or smaller.

An excellent custom is growing up, of requiring exhibitors to send in their pictures unframed. In some cases they are asked to use plain mounts of certain standard sizes, a choice of two or three being offered. The exhibition authorities display them by putting them on the wall covered with sheets of glass, held in position by pins. This departure has had a marked effect upon the work sent in. The cost of framing a number of pictures, and packing and despatching them so that they may reach the exhibition in safety was no trifle. We know one exhibitor who put this down, in his own case, at £100 a year. This expense limited the number of pictures sent in by any one competitor to a very few, and these of his own selection. A man is notoriously a bad judge of his own work: it is one of the most frequent comments on private view day, that the selecting committee has taken the poorest of any particular entry and rejected the best. The acceptance of unframed exhibits at least enables the exhibitor to send several, where before he might only have sent one; and so allows the selecting committee greater scope. There is a tendency amongst smaller exhibitions to follow this practice; or when they do not do so, to favour the simple and comparatively inexpensive form of protection known as *passe partout.*

The *passe partout* is not only a very economical method of showing a photograph, it is often extremely effective. The name is given to a card or mount, without any wooden frame, which is attached to the glass by means of strips of paper or linen at the edges. Rings are attached by loops of tape to the back of the card, by which to hang up the print. Materials can be bought for making these *passe partouts*, but there is

no need to limit one's self to these; and it is better, as far as final effect is concerned, to let the binding of the *passe partout* form part of the scheme of mounting. A stout card should be cut to the size of the glass, and the print with its paper mount may be fastened to this. Strips of the same paper, or of some other suitable tint, are carefully cut with a sharp knife and stuck to the glass, so as to form a margin of equal width all round. The paper may project 2 or 3 inches beyond the glass with advantage. Thin smooth paste is an excellent material for the purpose, and the strips should be allowed to dry, firmly adhering to the glass, before the print is put in position. It is then laid face downwards on the glass, and the paper, being smoothly folded back, is pasted down on the back of the card, the rings are attached by loops of tape glued to the card also, and the back neatly finished off by covering it with a piece of brown paper pasted on. Not only is this method cheap and very effective, but it reduces the size of the case when pictures are to be sent away, and reduces carriage also. It is often possible to send prints so mounted by parcel post.

A card backing was mentioned in the previous paragraph, because the *passe partout* is oftenest used in conjunction with what is called "the multiple method" of mounting. In this method the print is dried under pressure so as to be quite flat, and is then carefully trimmed to size. It is next touched at its two top corners with some adhesive—seccotine answers very well, or Higgins' mountant can be used—and is stuck on a piece of paper of a suitable tint. This paper is then trimmed down to some pre-arranged size, and it in turn is stuck on another paper by its top corners. This paper is trimmed down and mounted in turn on another, and so on. In this way the print is seen surrounded by a series of tints of different widths. By using one or more pieces of white paper, and trimming these only the slightest bit larger than the piece above them, we can get the effect of a fine white line; a dark line can be got in a similar way. This method is the most effective that can be devised, but is a snare for those who have not sufficient taste to use it successfully. Even when the different papers employed harmonize well enough, they may be used in such a way as to attract attention from the print to the method of mounting. The best papers to use for this

mounting are made primarily for book covers, but some of the brown and grey papers used for wrapping are very effective. This method is now seldom used except in quite a simple form, employing two or at most three pieces of paper. With more, and with varied papers, it easily becomes obtrusively elaborate.

The photographer who has succeeded in making prints that please himself, and is anxious to try his fortune at exhibitions, has plenty to choose from. Most of them are held during the winter months, the ball being opened by the two London shows, the "Royal" and the "London Salon," which run about contemporaneously in September, and should certainly be seen and studied by the aspirant. At that time lists of forthcoming exhibitions with open classes are published in the photographic journals, with the names and addresses of the secretaries; and a note to these will bring entry forms and full particulars. In filling up the form, the column "price if for sale" will, perhaps, puzzle most budding exhibitors more than any other. The usual price for an exhibition print, including the frame, varies from one guinea to five, beyond which very few are ever sold. A print 10 × 8 to 15 × 12 by an unknown exhibitor is not extravagantly dear or ridiculously cheap at a couple of guineas.

When a photograph is taken, a copyright in that photograph comes into existence, and is vested in the person taking the photograph, except in the case of work done to the order of any one else, as when one's photograph is taken by a professional photographer in the ordinary course of business. In that case the copyright belongs to the person ordering the photograph, unless there is an agreement to the contrary. The Copyright Act which came into force on July 1, 1912, did away with all necessity for registration or any other formality of any kind; it made the photograph copyright from the moment of its production. The copyright lasts for fifty years from the making of the negative; while photographs made before the act came into operation, whether they were registered or not, were similarly protected for any balance of the fifty years there might yet be to run, the act being retrospective in this matter.

This constitutes a great advance on any protection that had

gone before. There is no absolute compulsion to mark a photograph "Copyright"; but this should always be done before a photograph is allowed to go out of its author's hands, and the name and address of the author should also be given. The importance of this is evident. If an infringer proves that at the time of infringement he was not aware, and had no reasonable ground for suspecting that the work was copyright, one cannot maintain an action for damages against him, but merely one for an injunction to restrain from further infringement. Another important feature of the new act is that all transfers of copyright must be in writing.

The amateur photographer is sometimes in doubt as to how far he is safe in copying any work privately, for his own purposes or for amusement, and there seems to be an impression that so long as it is not done for sale it is not against the law. This is not so. The act defines copyright very explicitly, as "the sole right to produce or reproduce the work or any substantial part thereof in any material form whatsoever." Another point is that it is the photograph and not the subject which is copyright; that is to say that while one may not photograph a copyright photograph, there is nothing to prevent the original subject being photographed again. Nor is any restraint imposed upon the photographer of buildings, sculpture, etc., permanently situate in a public place or building. Provided the photography can be done without the photographer trespassing, he may photograph what he likes. There have been cases in which the owners of property have caused it to be photographed and the photographs copyrighted, in the belief that by doing so they secured a copyright in the building itself; but this was a mistake. The act makes this point quite plain.

As far as dealings with a professional photographer are concerned, any one ordering and paying for his portrait becomes the original owner of the copyright in it, and can permit any one to copy or reproduce it without any reference to whoever took it. He can also prevent its exhibition by the photographer in his window or show-case.

When prints are sent to a newspaper or magazine for publication, it should be made quite clear that they are sent for a specific purpose and for one publication only; or that

if they are used more than once a fresh fee will be required. The customary fee for a print and the right to reproduce it up to, say, about half-plate is half a guinea; but if the print has any special interest of any kind its value may be much higher, and the half-guinea should be looked upon as a minimum. For photographs of special value, or of an unique character, the photographer should consider whether he is likely to make most by selling a print to one paper exclusively, at an enhanced price in consequence, or by selling it at a low figure to all who will take it.

It is usual to submit prints in the form of enlargements on glossy bromide or gas-light paper, as size (up to whole plate at any rate) seems to count. Platinotypes, well-toned p.o.p. prints and carbon prints of a black colour, all make excellent blocks. Bromide enlargements on rough papers, especially when toned, and rough surface sepia or colour carbon prints are not suitable for reproduction in the ordinary way, nor are blue prints.

Some workers who have taken up photography merely as a hobby have been able to turn it into a remunerative occupation by the sale of prints for reproduction; as, since the half-tone process has leapt into universal use, the call for photographs wherewith to meet its insatiable demands has grown enormously. This has now become a recognized branch of journalism, and must be approached in the same way as any other. That is to say, the papers to which prints are to be sent must be noted, and their needs studied. It is a waste of time to send prints closely similar to those that have just appeared, and almost as great a mistake to send prints of a character totally different from those usually employed by the paper in question. The photographer must be prepared for rebuffs, and will want patience and photographic skill; but over and above this he will need what has been called the "journalistic instinct," to teach him what of the things which lie all about his daily path he can use as subjects for his camera. The least likely ground of success is the photography of great events, Royal visits, horse or boat races, and so on, which are arranged beforehand, and at which many of the illustrated papers concerned are represented.

Is the photographer who makes money in this way an amateur or a professional? asks the reader. Fortunately for photography the distinction between these two classes has

never been drawn by anybody whose decision or example is of importance. The great photographic exhibitions do not recognize it at all, membership and fellowship of the Royal Photographic Society is open to all photographers; most Photographic Societies have followed suit, and it is only here and there that the professional photographer is excluded from them, and then only by implication. Even then the construction of the word "amateur" would be broad enough to include any photographer who did not actually have a shop, showcase, or professional studio. The leading society has set an excellent example in this respect, and no one need hesitate to sell a photograph for fear of disqualifying himself as an "amateur"; the competitions or exhibitions where any distinction is drawn being very few and quite unimportant. This is only a natural outcome from the fact that, contrary to the case in other branches of work, the practice of photography as a profession is not any great help to success at photographic exhibitions. The professional photographer has to please his customers, and it is no exaggeration to say that the class of work which the public demands from him is not calculated to appeal to the judges at a photographic exhibition, nor would it be likely even to secure admission where there was any selecting committee. The professional has therefore to alter his aims and even his methods, if he would compete with other photographers; and the change is so great that his practice of photography, so far from being a help, is positively a hindrance, as far as the best exhibitions are concerned.

In Great Britain and Ireland there are now some two or three hundred societies and clubs of photographers; there are about one-fourth that number in the United States, and a fair number elsewhere. Some of these societies provide dark-room accommodation for their members, but most of them limit their activities to meetings once a week, or less frequently, and to excursions or outings during the summer months. Joining one of these societies is the easiest and quickest way to become familiar with the technics of elementary photography. Most of their members are beginners, or have been beginners not very long ago, and there is a co-operative spirit abroad in the clubs, which is very pleasant and helpful. As far as pictorial work is concerned, the postal clubs are perhaps the most useful. Each

of these has a circulating portfolio, to which the members contribute prints and a criticism of the prints of their fellow-members. The helpfulness of these clubs is shown by the fact that almost all prominent exhibitors have reached their position *viâ* a postal club.

In this country the amateur photographer has a weekly magazine which caters for his requirements, reproducing the leading pictures from the exhibitions, criticising them, holding periodical competitions and exhibitions, and generally acting as the organ of the pursuit. The *Amateur Photographer and Photography*, as it is now called, which is edited by the author, is an amalgamation of the four separate weekly journals which originally shared the ground amongst them. Formerly there were monthly magazines also, of amateur interest, but these have vanished.

Most of the larger Polytechnics in the big cities have their photographic classes, and, as a rule, these are open for a small fee to any one, whether intending to pursue photography for a living or only for a hobby. Each year the City and Guilds of London Technical Institute holds examinations, both theoretical and practical, which are open to students who can manage to attend at an examination centre. Such classes and examinations form a very sound basis for the photographer, but while going far beyond anything that is needed to produce exhibition work, or to follow pictorial photography, they in no sense offer anything of an art training to the student, who therefore has to approach pictorial photography far less well equipped than any one following one of the other graphic arts. In the absence, therefore, of a distinct taste for the scientific side of photography, the classes are not of much service; and all that is necessary can be learned at a photographic society, or from some friend who will act as teacher. Many do not even have this help, but pick up what technical knowledge they require from the manufacturers' booklets or their weekly paper. The processes have been so far simplified that quite sufficient information can be got in this way for a start; and practice thereafter will soon build upon that foundation.

CHAPTER XXVI

PHOTOGRAPHY AND THE PRINTING PRESS

Printing is of two kinds, intaglio and relief—Photogravure—Laying the ground—Printing the resist—Etching—Rotary Photogravure—Rendering half-tone—Line processes—The half-tone process—Ruled screens—Woodburytype—Collotype.

SOME of the earliest photographic experiments had for their object the improvement of printing processes, and the connection between the camera and the printing press has been continuous. It remained for what is called the "half-tone" process, which has been perfected within the last ten or fifteen years, to unite photography to ordinary printing so closely that it is now the exception for a book or newspaper to be free from photographic illustration.

Before we can understand how a photograph can be used by the printer, we must realize the distinction which exists between two fundamentally different printing processes. The type with which this book is printed, as every one knows, has its printing face standing up above the rest, so that when the inking rollers pass over it, the ink is left on that face, and is then transferred to the paper; in other words, it is printed from a surface in relief. Nearly all printing is now done in this manner. But there is a different plan—"intaglio printing." In this case the parts which are to carry the ink, instead of standing up above the rest are hollowed out by hand or by photography on a smooth plate of copper. The whole is covered with a particular kind of ink, the raised surface is then wiped quite clean, and a sheet of paper is placed on it and subjected to great pressure. When the paper is taken off it carries with

THE DOWNFALL PEAK OF DERBYSHIRE

BY W. R. BLAND

it the ink from the hollows of the plate, and so bears an impression of whatever was on it. In one case we see the ink is carried on a surface raised above the rest, in the other in hollows sunk below the general level. Both methods can be illustrated with an ordinary rubber stamp. Using it in the customary way, we are printing from it as a book or newspaper is printed—letterpress printing, as it is called; if we press it firmly on a well-inked pad, and then dab it gently on paper until the surface of the letters is free from ink, we shall then be able to obtain a negative impression of the hollows between the letters by pressing it very heavily on a clean piece of paper—a method which might be taken as representing intaglio printing.

Etchings, "copper plates" and "photogravure," are examples of intaglio printing, the latter being strictly a photographic process. A word of caution is necessary against confusing "photogravure," a term limited to intaglio printing from plates prepared by photography, with photo-engraving, which may be used for all methods, but is generally limited to the manufacture of process blocks for printing in relief.

Photogravure, which we owe principally to Fox Talbot, at one time promised to become an amateur's process, and quite a number of workers were etching copper plates from their negatives. It was "tricky" in its behaviour, but very fascinating, and some fine results were shown; but from the elaborate apparatus required if the amateur were to print from his plates as well as to etch them, or from the cost of copper-plate printing if the work were put out, photogravure seems to have lapsed into the keeping of professional engravers. The process is still unrivalled as far as quality of result is concerned, both for delicacy of gradation and richness of the deeper tones, the latter quality being due to the fact that in a photogravure print the surface of the shadows is a cast in ink of the hollow in the copper plate, which hollow has a peculiar and characteristic texture.

The process of making a photogravure plate is not very elaborate, although it calls for a good deal of skill. The first stage is the preparation of a reversed transparency; that is to say, the kind of transparency obtained by the single transfer carbon process, using glass instead of paper as the support.

If the plate is to be larger or smaller than the original negative the transparency must be made in the camera or enlarger, and a lantern or an ordinary dry plate may be used, but a carbon transparency is generally preferred. When this has been made it may be touched up, spotted, or otherwise modified at will, as although a positive image, it is to act as "the negative" from which to make the plate.

A polished sheet of copper, of a special and very pure kind, is taken, and has its surface treated in some way to give it a very fine grain or tooth of some substance which will not be attacked by the liquid used to etch the copper itself. Fine bitumen dust is generally employed, and as the coating must be exceedingly fine and even it is applied in a piece of apparatus called a dusting-box. This is a large wood box swinging on trunnions, with a door in one side close to the bottom of the box. A quantity of powdered bitumen or of resin is kept in the box. When a plate is to be prepared the box is turned over and over a few times, so as to shake up the dust, and is then fixed vertically. After waiting some seconds the door is opened and the plate on a suitable holder is inserted and left for the finer dust, with which the air in the box is still filled, to settle upon it. Then on taking out the plate, using great care not to disturb its coating, it can be heated gently so as just to melt the bitumen and cause it to adhere to the copper, but without making it so hot as to allow the particles to coalesce. This operation is called "laying the ground."

Using the transparency as a negative, a print is made on carbon tissue, a special form of which is supplied for this work. This print, which is called the "resist," is laid down upon the prepared copper plate and is developed there with warm water in the usual way. This is allowed to dry, and then the back of the copper plate and the margins of the picture are protected with varnish and it is ready for etching. Etching is generally done by means of solutions of iron perchloride, in which the plate is immersed and rocked, being watched the while. The perchloride makes its way through the film of gelatine forming the print, passing quickest through those parts, of course, where the film is thinnest. Here, therefore, the copper is most eaten away, and will hold the most ink when it is printed;

these must be the darkest parts of the picture, hence the necessity for printing from a positive and not a negative. The carbon print on the copper is a negative, and it is possible to watch the progress of the etching through its film. Different baths of perchloride are employed, starting with the strongest and finishing with the weakest, a paradoxical procedure which is explained by the fact that the weakest solution is the most rapid in its action, because it passes through the gelatine film more speedily than the stronger solutions. The strength of the etching liquid is generally measured with a hydrometer. The etching is the crux of the whole process. When it has gone far enough the plate is held under a strong stream of water and the film cleaned off it as quickly as possible, to stop further action. After washing it is dried, well cleaned with benzol to get rid of the varnish and of any remaining grain, washed again in weak acid, and polished. The plate is then ready for printing.

It would be quite outside the scope of this book to provide working details either of this or of any other process of photo-engraving; but from the sketch just given, the reader will be able to form some idea of the way in which a photograph can be reproduced in precise facsimile. There are many modifications of detail in photogravure processes, but the "Talbot-Klic" process, as the one just described is called, may be taken as the basis. The most notable departure is the process of rotary photogravure, which is now coming into prominence, and bids fair to challenge the all-powerful "half-tone." In rotary photogravure, instead of a bitumen ground, as just described, the carbon tissue forming the resist is given a brief exposure under a ruled screen, and is then laid down on the burnished surface of a copper cylinder, which is etched. This cylinder having been mounted in a suitable machine, a very liquid form of ink is applied to it very liberally, so that the whole surface of the copper is smothered with ink. As the cylinder rotates it passes under a steel edge, known as the "doctor," which has a slight reciprocating movement. The "doctor" removes all the ink from the cylinder, except what is lying in the etched hollows, and then the paper being applied to the cylinder with considerable pressure, the ink is taken off and so the impression is made. The process at its best yields results of great beauty, while it

can be worked rapidly enough, using a continuous web of paper and printing on both sides of it, to allow of its use for magazine and similar purposes, while it does not require the glossy surfaced, so-called "art" paper which is almost an essential of the half-tone process. It is too soon to pronounce very definitely on its future; but already it has come into use for purposes where hitherto the half-tone block was supreme, and there are many workers busily engaged in perfecting it.

The difficulty encountered by all the early experimenters in process work was that of the rendering of half-tones. A photograph in the ordinary way has for its highest light white or nearly white paper, and its deepest shadows of all may be black, but the intermediate tones are different shades of grey or brown, as the case may be. While white paper and black printing ink may very well stand for the highest lights and deepest shadows respectively, they cannot be mingled so as to form a grey; the impression given by the type must result either in the black of the ink or the white of the uninked paper. So long as we are dealing with subjects which are limited to these two, photo-engraving processes are much simplified. This is the case with what are called line subjects, which have a design made up of lines of black ink on white paper. In these the bitumen ground in the photogravure method just described would only be wanted with such a subject in order to hold the carbon "resist" to the copper; in practice a fine ground is always used, even for line subjects. The half-tones of a photogravure result from the thin coating of ink broken up by the grain of the etched surface, and as soon as Klic introduced the method of applying a bitumen dust to the plate before putting the resist down upon it, the problem of rendering the intermediate tones of a photograph by means of the black ink and white paper of a photogravure was found to be solved.

In relief printing, using the ordinary printing press and inking the top surface of the type instead of the hollows, the problem was not so easy, and many experimenters tackled it before the difficulty was overcome. The separate plates in this book are printed from half-tones; and a sketch of the way in which these have been produced may be taken as a type of the process. Unlike photogravure, it has never been an amateur's process, nor is it likely to become so.

The basis upon which these "half-tone" processes rest is that if the dots or stipple are small enough for the distance from which the picture is to be seen, the eye no longer realizes them as separate dots, but they appear like an even tint, dark or light according to the relative area of white paper and black ink exposed. If any of the plates in this book are examined at the usual distance from the eyes, they will appear to contain the most delicate shades of grey or brown; but if the same shades are examined with a magnifier, it will be seen that they are all made up of nothing but the full black of the ink and the full white of the paper, the only difference being in the size of the black dots, fine and widely separated in the lighter parts, large and joined up in the deepest shadows.

The original photograph from which a half-tone block is to be made can be either a print or a transparency. It must be a positive. The first stage is the crux of the whole process, and is the formation, from the print, of a negative in which the half-tones of the original photograph shall all be represented by black dots of different sizes on a clear-glass ground. To do this, the original is photographed, using for the purpose a special kind of sensitive plate, a glass plate ruled with black lines crossing each other at right angles—the "half-tone screen" or "tint" —being placed just in front of the plate in the camera. In the earlier experiments fabric was used for this purpose, gauze, crape, and muslin all being employed. The results were very poor, until it was recognized that the separation of the screen from the plate had a very important influence on the result. The theory of the action of the screen has been the subject of the most plentiful discussion, which need not concern us. Suffice it to say that the negative so obtained should be as free as possible from what the photographer calls half-tones, the high lights consisting of large black dots joined up at their corners so as to leave only small transparent spaces between them, while the shadows have clear glass with small distinct dots scattered over them. The half-tones of the original should be represented by dots of intermediate sizes according to the depth of the tone, but all the dots, as far as possible, should be opaque, and all the ground work transparent, and the edges of the dots as abrupt as possible. This effect can be helped by certain methods of intensification. The lens of the camera in

which this negative is made is fitted with a prism to reverse the image, right for left.

A copper or zinc plate is coated with an even thin layer of a preparation of fish glue, a kind of viscid gelatine, and bichromate. This is dried, and the plate is then placed beneath the half-tone negative just described, and printed. The effect of printing is to make the coating insoluble where the light has acted, just as in the carbon process. The plate, after printing, is wetted, immersed in aniline dye to stain the film and so assist the watching of the development, which is then carried out by means of cold water. The result is a metal plate, with an image upon it made up of dots and spaces of bare metal and of an insoluble gelatinous coating. This plate is then heated, by which the coating is "burnt in"—that is to say, made very hard and resistant, so that it will withstand the etching fluid. This may be dilute nitric acid for zinc, or iron perchloride for zinc or for copper. At this stage handwork is often introduced, portions of the plate being protected by varnish and the rest re-etched, the lengths to which this is sometimes carried being surprising. When originals are poor, and what is wanted is not so much a copy of the original as a good-looking result, "fine etching," as it is called, is very useful, but it may be considered to be carried too far when it leads to a pine tree being turned into a church spire, as it did on one occasion in the case of a half-tone ordered by the author. The plate, when finally etched, is trimmed up, mounted on a block of wood so that its surface is level with that of the type with which it is to be printed, and is then finished.

The glass screen through which the half-tone negative is made is formed by ruling parallel lines on glass with a diamond, and filling them in with pigment. Two such plates are cemented together with the lines crossing each other at right angles. The distance apart of these lines settles the fineness or coarseness of the texture of the block. A very coarse block is wanted for printing on newspaper, a finer one may be used on the better class of letterpress paper used in bookwork, such as that on which this is printed. For newspaper work the ruling of the screen may be such that sixty or fewer of the lines go to the inch. By using what is, most unhappily, called "art paper"—for it is anything but artistic, and is only a sad necessity—

much finer results can be obtained. This paper is provided with a very fine glossy surface, so that there is no need to have blocks with as coarse a texture as sixty lines to the inch. A hundred and fifty is more common in such cases. Two hundred lines to the inch is a very fine grain indeed, but blocks have been made with four hundred. These fine-grain blocks lose in richness what they gain in delicacy, and the best result is generally found to be got with from 133 to 175 lines to the inch, such as has been used for the plates in this book.

If the original, from which a block is to be made, has no half-tone, but is simply a drawing in black ink on white paper, the process is simplified. Take the case of the sketch reproduced on p. 212. There was no half-tone in this case at all; what was not black ink was white paper, so that no screen was necessary. The sketch was photographed to the required size, taking great care to get a negative with as clear lines as possible on a dark ground, and this was printed on a metal plate covered with some sensitive preparation, and then etched. The lines being clear, the coating under them is rendered insoluble, so that it remains and protects the plate, while its surface elsewhere is etched away and lowered. Then, when such a block is put into the printing press, the lines stand out above the rest, and take the ink and print as black lines on the paper. There being no half-tone to be rendered by fine dots, such blocks do not require "art paper," but can be printed with type on that paper with a duller surface that is generally used for bookwork, which is much pleasanter to the eye than the shiny coating of the "art" paper.

These processes by no means exhaust the connection between photography and the printing press. One of the most ingenious of all is called "Woodburytype" from its inventor, the late Walter Bentley Woodbury. In this process the first proceeding is to sensitize a thick sheet of gelatine with bichromate to print it under a negative, and to wash away the soluble gelatine with warm water. The result is a relief, a film in which the shadows are represented by the thickest parts, and the high lights by the thinnest, intermediate thicknesses standing for intermediate tones. This relief is placed on a smooth sheet of lead, and the two are put into a hydraulic press. The relief is forced into the lead, and every detail of the original

photograph is faithfully reproduced by corresponding depressions in the metal. The gelatine relief is uninjured by the process, and may be pulled off the lead and used to form other moulds in the same way. To print from such a lead surface an ink is used which is made by mixing finely ground colour with a solution of gelatine. The solution is of such a consistency that when cold it is a jelly, and it is applied to the mould hot. Some of the liquid ink being poured into the mould, a sheet of smooth paper is placed on top, a piece of plate glass is pressed down upon it, and the whole is put aside for a minute or two. The glass squeezes out the surplus fluid ink, and what is left sets into a firm jelly on cooling. When the paper is pulled off, it brings with it a cast of the lead mould in this jelly, which dries down into a faithful replica of the original. A good Woodburytype is almost indistinguishable from a carbon print; and, as in a carbon print, its half-tones are beautifully rendered by varying thicknesses of pigment in gelatine. The process fails when there is any large area of an even tone to be reproduced, especially if it is a light tone, as slight irregularities in the paper lead to corresponding irregularities in the thickness of the film. The squeezing out of the surplus ink also necessitates trimming the prints, and they have to be mounted. As printing is also very slow, the process has only enjoyed a moderate popularity for limited editions and is now rarely worked; but with subjects that suit it, a Woodburytype is the finest photo-mechanical rendering of a photograph that any one could wish to have.

Another process which cannot be passed by is collotype. This employs a principle closely allied to that which is the basis of carbon printing. It was early found that if a sheet of glass were coated with bichromated gelatine, and parts of it were exposed to light while other parts were not, and subsequently its surface were damped, that a roller with greasy ink passing over it, inked the surface where the light had acted, but left no ink on the parts where there had been no light action. We have seen one application of this in the "oil" and "bromoil" processes.

The discovery was worked out by Poitevin, Tessie du Motay, and others, and made commercially practicable by Albert. The method in outline is to treat the glass plate first

with a substratum of albumen, gelatine, and bichromate, which, drying and becoming insoluble, holds the actual printing coating firmly down. Albumen and sodium silicate (water glass, as it is called) is sometimes used as the substratum. The glass is then coated with bichromated gelatine, which may or may not contain albumen and other substances. Here arises the trouble which held back the half-tone process for so long. If we have black ink and white paper, how can we render the intermediate tones? In collotype this is surmounted in a very simple way. By drying the glass with its sensitized coating by carefully regulated heat, it will be found to dry with a fine grain, which splits up the image exactly as we want it. The plate so prepared is printed under a negative, and is then soaked for half an hour. If plain water were used for the purpose, the plate would have to be soaked for each print, but by using one part of glycerine to three of water this is not necessary. After soaking, the surplus liquid may be wiped off with a sponge, and the plate is ready to be inked up.

The inking of a collotype plate, and indeed of any plate that is akin to lithography, is a curious process. Let us suppose we have our roller well coated with greasy ink and we run it slowly over the glass, using a fair pressure, after a few strokes the entire surface of the glass will be covered with ink. Then, instead of continuing to roll slowly and heavily, we roll as quickly and lightly as we possibly can, and we shall find that we can remove almost all the ink from the glass. Between these two methods is an intermediate one, which will leave just the right quantity of ink on the glass to give the impression required. A piece of paper being laid on the glass, it is brought into contact with it in a press of a particular type. Behind the paper is placed what is called a tympan, a sheet of thin metal or other material in a frame. The flat, rounded edge of a "scraper" presses on the tympan, and the glass, paper, and tympan being drawn under the scraper, the paper as it passes is brought into close contact with the glass plate. The tympan being raised the paper print is taken off, the plate re-wetted if it need it, inked up again, and a fresh impression is pulled.

Modified collotype is quite within the power of an amateur photographer, and wants very little in the way of apparatus;

and at least two processes—"Sinop" and the "Photo-autocopyist"—have been put on the market to meet his needs. In these a letter-copying press can be used for printing, or even the domestic wringer can be employed at a pinch; while in the photo-autocopyist, paper coated with gelatine and stretched on a frame is used instead of the glass plate. Either method will give very fair results without much practice, and, where more than a few prints are required, is worth consideration.

The processes above described do not exhaust the list. Photozincography, photolithography, stannotype, and other methods might all be dealt with, as links between the camera and the printing press. But some of these are obsolete, and others have limited applications only, so that the merest mention must suffice. The growth of half-tone, not only in popularity, but in the quality of the results, has already made it overshadow all other processes; and although, for reasons inherent in it, it is not likely ever to surpass photogravure, it is not at its best so very inferior, while the cheapness with which good work can be turned out has caused it up to the present to fill a far wider field of usefulness.

L'ENVOI

THE broad roads of landscape and portraiture are followed by the great majority of amateur photographers, and the processes which have occupied us so far seem enough to meet the needs of most of them. But the camera can be applied to so many purposes, and so many processes and methods can be applied to it, that the bypaths open to the photographer are almost countless. Delightful, too, is it to follow whither our tastes lead us, to photograph crocuses or comets, to show our pictures burnt in on porcelain or in the fleeting blue print. There are a dozen or more of such bypaths which has each a treatise to itself.

Take wet-plate work for an example. The very smell of the ether has a fascination for some, while the direct personal contact between worker and process has no parallel in any other photographic method. The wet-plate photographer cleans his glass and dirts his fingers, coats his plate, sensitizes it, exposes it, develops it, and dries or smashes it as he may think fit, and all within an hour. Dirty glass at ten, at eleven may be in the printing-frame. There is no such feeling of "Alone I did it" to be obtained by the user of the dry plate of commerce, containing he knows not what, and made he knows not how. It is said to yield very fine slides; but comparatively few amateurs now living have ever tried it for this purpose. There are some very pleasant hours before any one, whose tastes run more towards processes than pictures, in learning to make a good wet-plate lantern slide.

Own brother to the wet plate is collodio-bromide. The

pundits who differ on all else agree that never were such slides as those which can be made on collodio-bromide. The process is not so messy as the wet plate, since although silver nitrate plays a part in it, that part is played in the seclusion of a bottle, where bromide soon renders it harmless to the skin of the photographer. In collodio-bromide we have the realization of Gaudin's dream, a fluid which is poured over a plate, dried, and it is at once ready for exposure in the camera. It is the wet plate with the coating of the glass put last instead of first. The collodion has silver nitrate and a soluble bromide added to it in the dark room, and thus has silver bromide formed within it. The creamy liquid is poured out into a dish for its ether and alcohol to evaporate, and the leathery mass so left is washed in water to get rid of the soluble salts, the result of the emulsification, and is then once more redissolved to form a collodion. These earlier stages of collodio-bromide work need not be carried out by him who would use the emulsion. He can buy it ready made. He cleans his glass, pours on the emulsion, and in a few minutes it is dry and ready for exposure. The plate is not quite so fast as an ordinary lantern plate, but is rapid enough for slides by reduction in the camera. It is developed with pyro-ammonia, fixed with hypo, and, like the wet plate, can be washed thoroughly, thanks to its thin film, and dried off by heat in a very few minutes. Without going so far as to say that slides, as good as collodio-bromide slides, cannot be made on gelatine lantern plates—we believe they can—it is only bare justice to a very beautiful method to admit that when it was *par excellence* the slide-making process, the average of lantern slides that were shown was very much higher than it is to-day.

If we go from these to printing methods, there is the simple "blue print," which survives, as the Darwinians tell us some of the lower forms of life survive, from the extreme simplicity of its structure. The blue print needs nothing but a good washing in water to reveal its full vigour (such as it is) and to confer its greatest permanence (with the same proviso understood). Blue printing-paper has its uses outside that chief one which it finds in engineers' and architects' offices. An ingenious photographer has told how he papered a room with highly glazed blue prints from his negatives,

simulating thereby Dutch tiles. This, perhaps, is not so much a use as an abuse. Blue prints are handy as furnishing the simplest method of cataloguing negatives. There are certain subjects which the colour is said to suit, and we live in the hope that one day we may see such a subject. The paper is simplicity itself—not merely to use, but to make. The sensitizing solution is made by dissolving a quarter of an ounce each of green ammoniocitrate of iron and of potassium ferricyanide in an ounce of water each, and mixing the two solutions. It can be applied with a brush or sponge to the paper, and the blue print is not at all particular about its paper; so long as it is fairly well sized it may be anything almost, and as soon as it is dried the paper is ready. It takes longer to print than P.O.P., but not so much longer; while half an hour's washing in cold water is all the after treatment. The picture so obtained can be toned in many ways, and made to yield every colour from black to yellow or green, according to the treatment adopted.

Kallitype is another printing process—or rather was, for little is heard of it now—and a batch of kallitype prints turned out of a drawer the other day bore no sign to distinguish the front of the paper from the back. The image which once had been vigorous enough, had folded its tents like the Arab and had silently stolen away. The sensitizing solution in this case was a mixture of silver nitrate and ferric oxalate, and the developer Rochelle salt and borax. Prints made on plain "salted" paper, as it is called, at about the same date, were as good as ever; and many may like to try that method, because, while giving any of the colours we are accustomed to get on a silverprint, we can select any paper for the purpose that suits us, provided only it is reasonably pure. The paper is floated on the surface of a warm solution of gelatine, salt, and citric acid. Half an ounce of gelatine, 1 dram of common salt, and 2 drams of citric acid to 7 ozs. of water will serve as a type of the solution used. It is then dried, and keeps in this condition indefinitely. It is insensitive; and so, not more than a day or two before it is to be used, it is floated on a solution of silver nitrate of a strength of 40 grains to 1 oz. of water. After two minutes floating, it is hung up and dried in the dark. Such paper prints very quickly, and, when

printed, is washed and toned either with gold or platinum. The platinum toning bath, as used for P.O.P., is very suitable for it. Rough drawing papers, such as Whatman or Joynson, answer very well, and there are many who like the results obtained in that way more than those on rough bromide or platinum paper. The process is very simple, and the image prints right out. It is a bypath likely to appeal to the picture maker more than most.

The Stereoscope is an instrument which is a capital test for separating the sheep from the goats, the scientific from the pictorial photographer. Readers must decide for themselves which group shall be represented by the sheep. Certain only is it that while those people who are most interested in the technical side of photography are fascinated by the stereoscope and the effect it gives, even if they are not stereoscopic workers themselves, the artist feels that what one regards as extraordinary realism is to him glaringly and repulsively false. The question, like so many others, is one of standpoint or mental attitude. To one concerned with things as they are, the way in which the stereoscope gives a sensation of relief or depth to the picture seems true enough; to the other, the suggestion of reality, instantly contradicted by the absolute rigidity of every part, is a discord of the harshest kind. The author is, perhaps, prejudiced against the stereoscope. Its pictures seem so brittle in every part; they are regarded under conditions of discomfort, peering into eye-pieces for a result which hardly justifies even so slight a trouble; the relief is so assertive that the view in the stereoscope cannot be looked at in the light of a conventional representation, as every true picture is, quite unconsciously. It masquerades as the real thing, but the disguise is not good enough.

One of the most remarkable of modern developments in photography is the kinematograph or "cinema." In this a series of little pictures are taken on a continuous band of celluloid film, printed on a similar film, and then projected in rapid succession on a screen. By the use of alternating colour screens, both in taking and projecting, a very fair colour-rendering can be obtained. There have been various attempts to popularize amateur kinematography; but the cost of the apparatus and of the films has been sufficient to prevent their

success, and the production of "living pictures" has become a distinct and extensive industry.

Twenty years or so ago, more was heard than is heard to-day of a very beautiful process, giving results of greater permanence in all probability than any other. Photo-ceramics, or photographic enamels are photographs which have been transferred to the surface of porcelain or enamel; the vehicle supporting the photographic image being removed and the picture itself fixed into the porcelain and glazed over, so as to be almost indestructible, except by actual smashing.

Porcelain is not the only substance available. Photographs may be absolutely incorporated into the surface of a glass plate, and a Leeds amateur adapted "the pepper process," as it was called, to the making of lantern slides, which thus need no cover glasses. The name is due to the sensitizing solution, which is an extract of pure white pepper obtained by means of benzol. Glass is coated with this and dried, and is then printed under a positive transparency, not a negative. When sufficiently printed, it is brushed over with finely powdered enamel colour, which adheres to the parts which were protected by the positive, but not to the parts on which the light has acted. In this way a picture, composed of the enamel colour, is built up on the glass, and when it is seen to be strong enough, the glass is heated until its surface and the enamel fuse together.

Turning for the moment from processes to their applications, what a vision opens out of the usefulness of the camera. The photographer no longer appears merely the suave gentleman in frock-coat and immaculate cuffs, who asks to have the "head a little up, please," or "there, like that's" us, at a charge not so far removed from that of the dentist; nor seems he the humbler follower of the craft, with stained fingers and persuasive air, who offers to do us "Just as you are for ninepence;" nor even as the stolid automatic machine that expresses, in print, its willingness to be put into operation by a couple of pennies—a willingness which too often, alas! is contradicted flatly by its subsequent behaviour. We see the photographer in his wider sphere directing the camera-telescope towards the heavens hour after hour, while stars forever invisible to the human eye aided no matter by what triumph of the optician, pile up the accumu-

lating record of their existence into a developable speck that is our only hint of a universe more wondrous and perhaps more vast than our own. Or, at the other end of the scale, the same principles and the same methods are recording those modern demons that can sit in myriads on a pin-point, yet whose internecine strife in blood and tissue may be fraught with life and death to any one of us. The bacteriologist finds his greatest auxiliary the camera ; the astronomer learns from it the composition of the comet and the structure of the stars ; the spectroscope writes in invisible light a visible inscription on the plate : and we may yet see the day when the correspondence of the nations can be conducted through a single wire and written at the speed of light itself on the photographic film. That is more than the vision of a dreamer, and already, experimentally at least, the speed of recording telegraphy has reached a point almost beyond conception. When the provoking moralist flaunts before us the wondrous adaptability of the elephantine trunk to uproot a tree or uplift a needle, or the hackneyed steam-hammer is put into operation to forge a propeller or to crack a nut, let us remember that we need not go beyond our own hobby to point the moral and adorn the tale to a far more wonderful extent. The process that is helpmeet of the sciences and recorder to the world, is equally ready to while away an hour for us as the freshest and most fascinating of hobbies.

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